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KEYBOARD MANIA — Part 1

By Cedric R. Bastiaans

I. INTRODUCTION

Sir Clive, the man who brought powerful, but affordable computers to the masses (and still does, in mainland China for instance), appears not to be too pre-occupied with keyboards. Both the ZX80 and the 81 sported so-called membrane keyboards. Granted, they are inexpensive and quite reliable, but they really have no business being on a computer. They are user- UNfriendly and only belong on appliances, where the "keys" get activated only once in a while (blenders, toaster ovens and the like).
Membrane keyswitch assemblies are still around, but they have come a long way, now with full travel actuating keys. It is the membrane keyboard, which is directly activated by human fingers, that I despise. The Commodore 64 would not have enjoyed its immense worldwide popularity, if Jack Tramiel would have given it a membrane KB like the ZX81 (or TS1000).

Anyway, I think that a real, full travel keyboard (KB) is a must for any computer! It was one of the first things I did, back in 1981: put a professional KB on my ZX81. I still have it; it has 10 dedicated keys, i.e. keys that effect functions that would otherwise require the actuation of two keys simultaneously.
I know that many amongst you think that the TS2068 KB (which is not a membrane keyboard, but is not a full travel type either), is heaven compared to the KB on the ZX or TS1000. It is without a doubt a great improvement, but it still is a very inadequate KB for computers, certainly if the machine is used for word processing. Should I remind you of the so-called space bar with its annoying problems of sticking and multiple spaces or not working at all unless you hit it dead center? If you have never worked with a real KB, you just don't know how pleasurable keying on a full travel KB is. Even the QL, with its membrane KB activated by wobbly rubber blocks is far from meeting the criteria of a pro KB.
I have improved a couple of computers with pro keyboards and would like to share with you a couple of circuits I have used for dedicated keys, give some pointers on KB's in general and suggestions on improved keytops, all for the TS2068.

II. CHOICE OF KEYBOARD

The KB should be of the mechanical switch type, with full travel keys and positive action. There are many surplus or reject KB's available from a variety of sources. Make certain that you get one with straight electrical contacts, so-called single-pole,single-throw (SPST) types. There are KB's that use exotic ways of "making contact", such as the ones using capacitive or Hall-effect "switches". Not only are these expensive, but they are also very difficult to adapt to our needs.
Also, don't buy so-called ASCII-encoded KB's; the electronic circuitry on it is not needed and therefore wasted. Sometimes though, they can be had real cheap; just make sure that the keys are SPST mechanical switches and discard the electronics.
And beware of membrane KB's (even though they might be of the full travel type), because their matrix is practically always part of the flexible membrane printed circuit. Since it can not be expected that the matrix of a keyboard, not originally built for a TS computer, would be identical to the matrix we need, you should expect having to modify the printed circuit board (PCB) of the KB you acquire. This entails cutting copper traces and making new wire connections. And that is something impossible to do with the membrane circuit.
As I am writing this (Dec.15'85), Radio Shack has a special purchase item 277-1020, a 75-key KB selling for $6. It is a membrane type with very good and light-touch, full travel, beautifully sculptured keys. It has however, an incompatible matrix and it can not be easily modified. A real pity...

As far as the tactile "feel" of the KB keys goes, that is a matter of personal taste, but maybe I can give you some guidance. One of the very best KB "feels" can be experienced with the KB of the Canon Typest*r 5 electronic typewriter.

Once the head is positioned over the desired track, the sector register is loaded with the desired sector and a READ SECTOR command is issued. This causes the disk controller to read the ID fields as they pass under the head until one of the correct track and sector number is located. The data in the corresponding data field is read in. If an ID field with the right track and sector is not found within one revolution, an error is reported and the disk software usually issues a RESTORE command and tries a few times before giving up and reporting a disk error to the user. Writing a sector follows the same stages of head positioning and of reading ID fields to find the correct sector only; instead of reading the data in, the new data is written out to the data field.

The only remaining problem is [illegible] a disk ever gets formatted in the first place. [illegible] cannot be written using a WRITE SECTOR [illegible]y changes data in the data field. [illegible]2 and most other controller chip [illegible]RITE TRACK command. Both of these c[illegible]:ture of a track and simply take [illegible]r the start of a track which is e[illegible]ntirety. To format a disk, the form[illegible] pattern described earlier onto eac[illegible]: TRACK command.

We have come [illegible]f articles first appeared in LIST, [illegible] go before the level of disk and [illegible]ar, all that the disk drive and the [illegible] is store and recall chunks of da[illegible] final stage in making the floppy d[illegible]..y this collection of sectors into named [illegible]. where hardware and electronics gives way to softwar[illegible]ne DOS or DISK OPERATING SYSTEM.

If time is on my side and positive response from the past DDC&I articles is forthcomming, I will then continue the series with an explanation of the disk drive hardware and attempt to outline the DOS structure. Please advise your LIST editor.

.....Bob Gilder

LIST Group

A glossary of keyswitch technologies

Electromechanical:
Two moving metal contacts touch one another in a butting action, producing the keyswitch actuation.

Capacitive:
A hinged foam pad or metal plate moves toward a plate on a pc-board substrate, generating a change in capacitance and the subsequent key actuation.

Hall-effect:
Pressing a key toggles on a solid-state Hall-effect switch in the presence of a permanent magnetic field. The switch incorporates an IC containing a Hall generator in addition to a trigger circuit and amplifier.

Ferrite-core:
Key actuation causes a single-turn transformer to couple a scanning pulse to a sensing wire. A plunger magnet saturates the switch's ferrite core in the off position to inhibit coupling.

Reed:
A permanent magnet built into the switch plunger moves into close proximity with the reed, which reacts by flexing and opening the contact.

Membrane:
A conductive switch pattern containing silver contacts is screened onto two flexible Mylar sheets, both sandwiching a spacer layer. Actuating the keyswitch causes the upper membrane layer to press downward and make contact with the lower layer.

Conductive-rubber/elastomer:
Molded silicone rubber or nonsilicone rubber elastomer domes, each containing a bonded carbon pad, contact an etched switching element on a pc board.

Table 1. Comparative Keyswitch Reliability

Technologies	Operating cycles (in millions)
Electromechanical	10-100
Capacitive	100
Hall-effect	100
Ferrite-core	100
Reed	100
Conductive-rubber/elastomer (rubber, lowest; elastomer, highest)	5-100
Membrane	10-75

You could therefore enter a store which carries them and try one out. Who knows? Maybe you will even buy one! (I think it's a fabulous typewriter).
But since you are a member of that masochistic lot, also known as Sinclair computer addicts, and have endured pain with chintzy KB's for heaven knows how long, you probably would go "gaga" about any full travel KB!
A good source for surplus keyboards is Jameco Electronics, 1355 Shoreway Road, Belmont CA 94002; their item KB54, a 54-key KB sells for $10.
Another one is ITC, 9119 De Soto Avenue, Chatsworth CA 91311, but they have no catalog and do not accept mail orders.

III. KEYBOARD MATRIX

In the foregoing, the word "matrix" has been used several times and therefore requires explanation, in case you don't already know. The TS2068 has 42 keys, but 2 of them are in duplicate and wired in parallel, CAPS SHIFT and BREAK (or SPACE), so that a matrix of three groups of lines, one with 5 and two of 4 lines each, can be and is indeed used to enter the 40 (=5x2x4) principal key functions.
This matrix is shown in Figure 1.

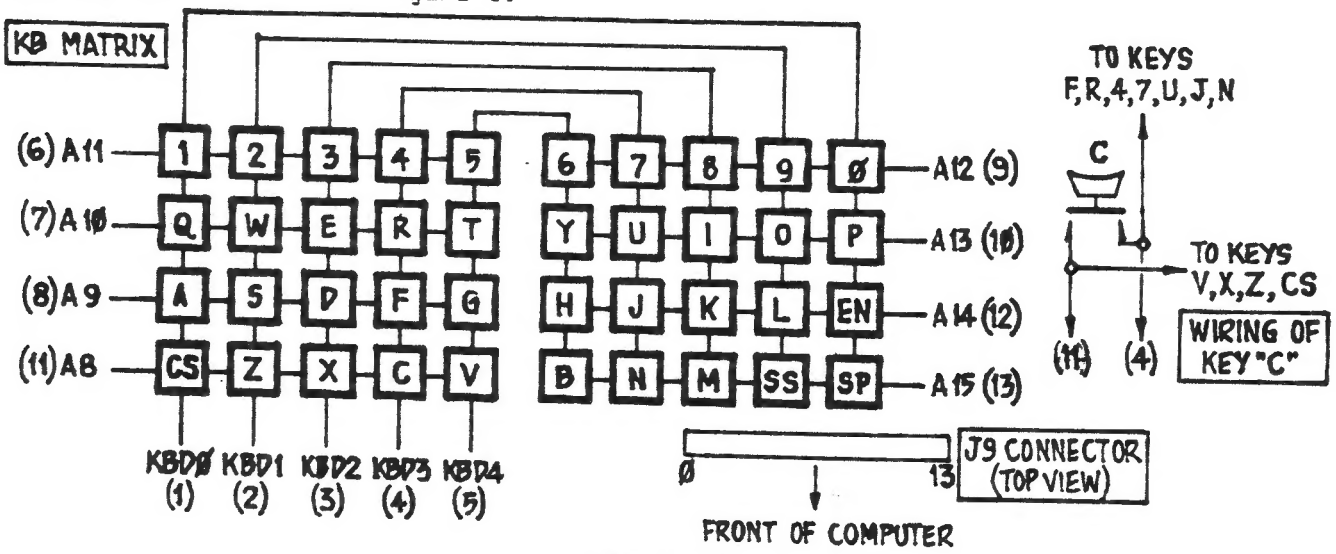


FIGURE 1

Each block depicts a key and is marked with the principal character on that key. Whenever a key is pressed, the two lines intersecting at the corresponding block become electrically connected. If you would press key "5", lines A11 and KBD4 will connect, whereas pressing "6" joins lines A12 and KBD4. This matrix will be helpful in modifying the printed matrix of any suitable surplus KB you might purchase.
Incidentally, the matrix for the ZX81/TS1000 is almost identical to the matrix shown in Fig.1; the only difference is that a "period (.)" key is in place of the Symbol Shift key, and the line numbering is different.

Since we deal with logic circuits and extremely low electrical currents, the key contact need not have the low resistance normally encountered in mechanical switches. A contact resistance of several hundreds of ohms will still generate the desired function and under certain conditions will even be beneficial, as we will see later.

The lines connect to the 14-pin KB Interface Connector J9, which is on the main PCB inside the computer. This connector has .100" pin spacing and normally mates with the flex cable of the original TS2068 KB, but the surplus KB can easily be connected with a flat cable and a connector made of headers for socket connectors, which come in strips of 36-pin size, notched for easy breaking to desired length. If you wish, you can of course unsolder and discard connector J9 altogether and solder a flat cable, much like an umbilical cord of the KB, directly to the computer's PCB.
The connector pinout is also shown in Fig.1; #0 is ground, the remaining 13 (=5+4+4) pins are the KBD and A lines and these pin numbers are also shown in parentheses near the line identifications of the matrix.

The illustration also shows how the two terminals of each key-switch should be connected to the lines.

To facilitate the choice of connections and circuits for dedicated keys, and also the check-out of matrix wiring after it has been modified, the table of Fig.2 has been composed. It shows for each principal character and function, the required connections, which are indicated as groups of pin-out numbers of J9.
Thus, if for instance the Symbol Shift key is pressed, pins (or lines) 2 and 13 should show an electrical connection, which opens up again when the key is released.

A	1+8	F	4+8	K	3+12	P	1+10	U	4+10	Z	2+11	5	5+6	0	1+9
B	5+13	G	5+8	L	2+12	Q	1+7	V	5+11	1	1+6	6	5+9	SS	2+13
C	4+11	H	5+12	M	3+13	R	4+7	W	2+7	2	2+6	7	4+9	CS	1+11
D	3+8	I	3+10	N	4+13	S	2+8	X	3+11	3	3+6	8	3+9	SP	1+13
E	3+7	J	4+12	O	2+10	T	5+7	Y	5+10	4	4+6	9	2+9	EN	1+12

Note: SS = Symbol Shift; CS = Cap Shift; SP = Space Bar; EN = ENTER

FIGURE 2

IV. DEDICATED KEYS

The question of which functions or symbols to put on dedicated keys is largely dependent on the number of extra keys available. Secondarily, it is a matter of personal taste; I have read a number of articles about keyboards with some simple dedicated keys and was always rather puzzled as to why the writers of those articles chose the functions and symbols as they did. You should really ponder this matter very seriously, but of course the more extra keys the KB has, the easier the choice is going to be. Determine which functions and symbols are used the most; they are obvious first contenders. Do keep the two Caps Shift keys, one on either side of the bottom row. I also suggest to have two Symbol Shift keys, one next to each CS key. DELETE would be my first choice for a dedicated key, then function GRAPHICS, the period (.), the comma, the colon, semi-colon, the 4 arithmetic functions with the =sign, the ?, the !, both parentheses, the quotation mark, the $-sign and the Extended Mode function.
The table of figure 3 shows suggested functions and symbols, together with the required KBD and A line junctions, again expressed in terms of the J9 pin numbers. Because they require the simultaneous actuation of either the SS or the CS keys, the required junctions each show TWO groups of connections, the first one of which is for either of these shift functions.

? 2+13/4+11	; 2+13/2+10	= 2+13/2+12	(2+13/3+9	← 1+11/5+6	ED 1+11/1+6
! 2+13/1+6	+ 2+13/3+12	↑ 2+13/5+12	) 2+13/2+9	→ 1+11/3+9	CL 1+11/2+6
. 2+13/3+13	- 2+13/4+12	" 2+13/1+10	@ 2+13/2+6	↑ 1+11/4+9	GR 1+11/2+9
, 2+13/4+13	* 2+13/5+13	' 2+13/4+9	# 2+13/3+6	↓ 1+11/5+9	DE 1+11/1+9
: 2+13/2+11	/ 2+13/5+11	$ 2+13/4+6			EM 1+11/2+13

Note: ED = EDIT; CL = CAPS LOCK; GR = GRAPHICS; DE = DELETE; EM = EXTENDED MODE

FIGURE 3

The table shows for instance that in order to create the $-symbol, pins 2 and 13 should be connected (Symbol Shift), as well as at the same time pins 4 and 6 (the "4"-key). Another example is the semicolon; this character requires that pin 2 is again to be connected to pin 13 (SS), but ALSO to pin 10 (the "0"-key).
Still another example is the multiplication or asterisk symbol *; it requires that pin 2 should connect to pin 13, which in turn should also connect to pin 5 ("B"-key).
With the help of the table Fig.2 you can of course determine the junction combinations necessary for any symbol or function not shown in the table Fig.3.

In the next installment of this article series we will discuss exactly how to effect all these connections.

V. DEDICATED KEY FUNCTIONS WITH A COMMON KBD-LINE

There are 7 (seven) key functions which require one KBD-line to be connected to two different A-lines, refer to the Table of Figure 3 in Part 1 of this article series.
These functions are the

colon : requiring pin 2 to be connected to pins 13 and 11,
semicolon ; requiring 2 to be connected to pins 13 and 10,
equal sign = with pin 2 to be connected to pins 13 and 12,
closing parenthesis),2 to be connected to pins 13 and 9,
"at" sign @ with pin 2 to be connected to pins 13 and 6,
EDIT key, requiring 1 to be connected to pins 11 and 6,
DELETE key, with pin 1 to be connected to pins 11 and 9.

The @ sign might only be useful as a dedicated key function for those of you who use the A&J microdrive. The remaining functions should be carefully chosen if you do not have a whole lot of spare keys available in your keyboard. DELETE would be a first choice, with : and ; next.

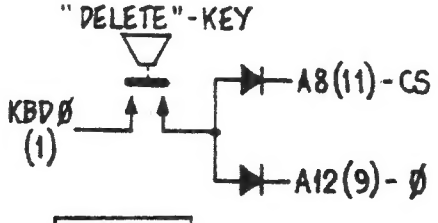


FIGURE 4

Allright, now how to effect this? Bearing in mind that current flows from KBD to A, it is quite simple, as Figure 4 shows. The diodes (silicon type, either 1N914 or 1N4148), are needed to prevent the A-lines from connecting together; we only want them to connect to the KBD-line.

I suggest that you DON'T BUY the so-called Radio Shack Archer Packs when you go shopping for diodes. These are very cheap (50 for less than $2), but may not always be of reliable quality. Catalog item 276-1122 (10 for $.99), on the other hand, is of quite acceptable quality.

VI. DEDICATED KEY FUNCTIONS WITH A COMMON A-LINE

Likewise, there are as we can again see in the Table of Figure 3, 3 (three) functions that require two different KBD-lines to be connected to one common A-line. These are the

period . which requires pins 2 and 3 to be connected to pin 13,
comma , which requires pins 2 and 4 to be connected to pin 13,
asterisk * which wants pins 2 and 5 to be connected to pin 13.

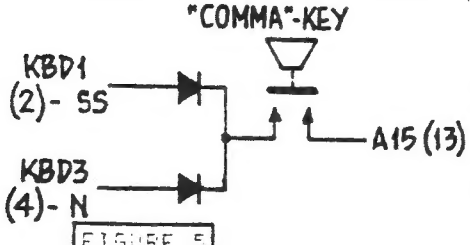


FIGURE 5

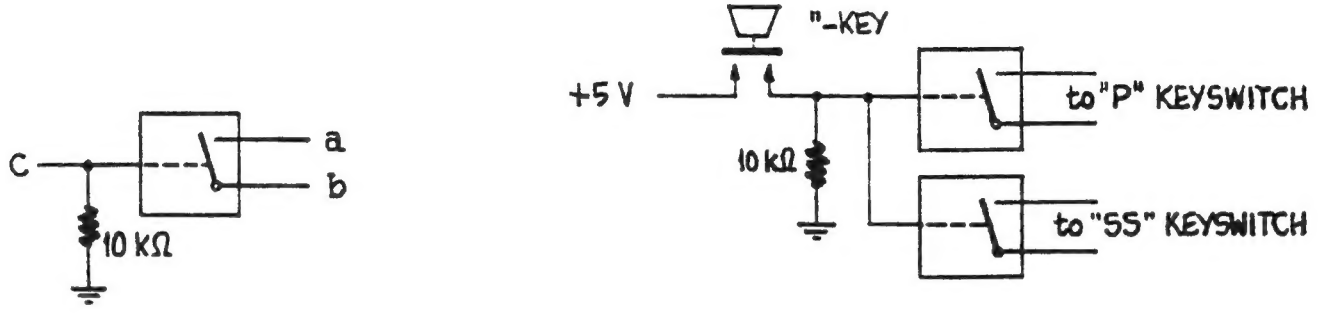
Again, we use diodes. Now to isolate the KBD-lines from each other, and Figure 5 shows the way to hook things up. The same observations as made in the preceding paragraph of course hold here too.

VII. THE REMAINING DEDICATED KEY FUNCTIONS

All of these require the switching of TWO independent line pairs. Of course, if our keyboard had DPST (double pole single throw) switches, this would be readily

possible to do. But if there are keyboards like that, I have never seen them. There is, however, an elegant electronic way of doing just what we want.
Let me introduce you to the solid state switch, the so-called bilateral switch. I have adopted the symbol shown in the next few illustrations; I think that it shows the switching concept in terms which are more readily acceptable to most engineers and technicians. The official symbol is in my opinion confusing and meaningless.

Figure 6(a) shows the basic switch, which is NOT a mechanical switch but a semiconductor device. The 10 kilohm resistor keeps the control input (c) LOW; the resistance between points (a) and (b) is then extremely high, typically more than 1000 megohm. For all practical purposes, "contacts" (a) and (b) are OPEN.



(a) FIGURE 6 (b)

Should we, however, bring control point (c) HIGH, by for instance connecting it to +5 volts, the resistance between (a) and (b) would drop to a few hundred ohms, the exact value depending on some parameters, the supply voltage being the most influential parameter. As we have stated before, a few hundred ohm between a KBD-line and an A-line is sufficient to produce a character.
One such solid state switch would of course not do, but we can tie TWO together, as shown in Figure 6(b) and we would have a DPST switch!

The real beauty of these circuits, however, is shown in Figure 7. The dedicated functions require either a simultaneous Symbol or Caps Shift "contact closure" and we could therefore create a SS-bus and a CS-bus, each requiring only ONE solid state switch. The latter could then be activated by any one of the dedicated keys!

Figure 7 shows such a bus configuration for the CS function, with just THREE dedicated keys shown as examples. There is no limit to the number of solid state devices that you may use with one Shift Bus! Diodes are again used to isolate circuits; we do not want the activation of a bus to cause all dedicated key circuits connected to that bus, to be activated as well.

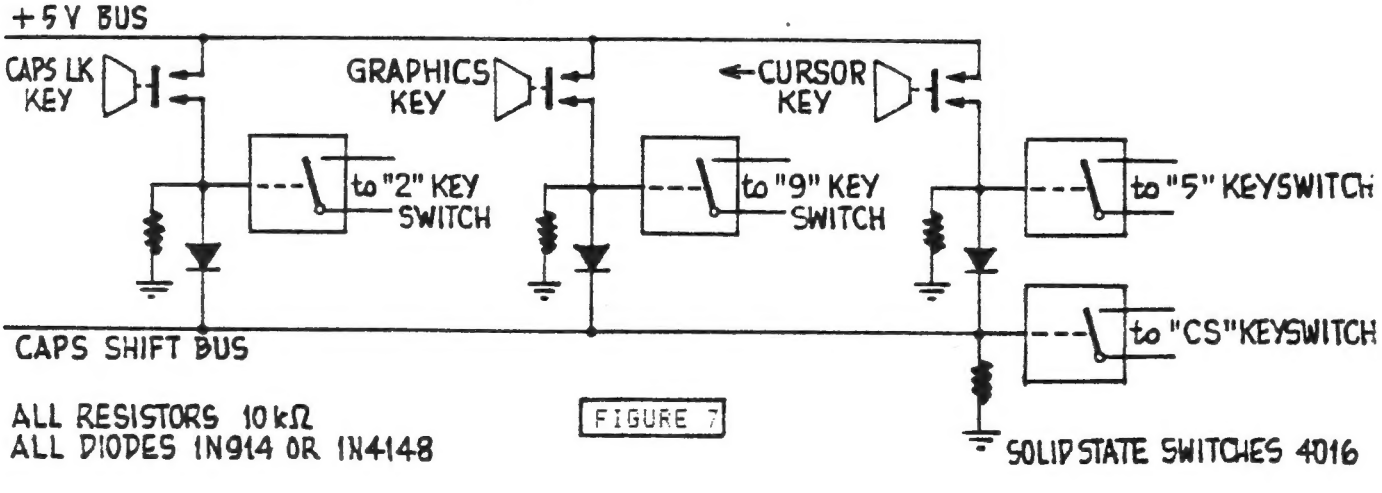


FIGURE 7

VIII. EXTENDED MODE DEDICATED KEY FUNCTIONS

Having two Shift Buses, one for CS and one for SS, allows the logical choice of another dedicated key: the EXTENDED MODE. All that is needed is the key and two diodes, as shown in Figure 8. Pressing this EM-key puts the control lines of BOTH solid state switches HIGH, thusly creating the EM-function!

I went a step further with my surplus Key Tronic Corp. keyboard with 77 keys. I dedicated eleven keys in the extra top row to often used EM functions. These keys are immediately to the right of the dedicated EM key and are wired directly in parallel with selected standard keyswitches. For instance, such a key connected to the "A"-key would, after the EM-key had been pressed (making the E-cursor appear on screen), when pressed cause the "READ"-function to show! I selected for these special keys, such functions as READ, DATA, RESTORE, STR$, CHR$, INKEY$, USR, LLIST, LPRINT, SQR and EXP. I found these to be extremely handy!

And what about the EM-functions that require an additional SS shift, after the E-cursor has appeared? Easy.
Yet another ramification of the idea: to thusly access often used commands, as for instance CAT, ATTR and others, used in disk drive operating systems. These are simply accessed with already EXISTING dedicated keys, which activate the SS function. For the two aforementioned functions, these would be the) and the = key! The keytops for these dedicated keys would simply show TWO symbols or legends, for instance = in black (on a white key) and ATTR in black on a blue background, which is the color of the EM-key on my KB.

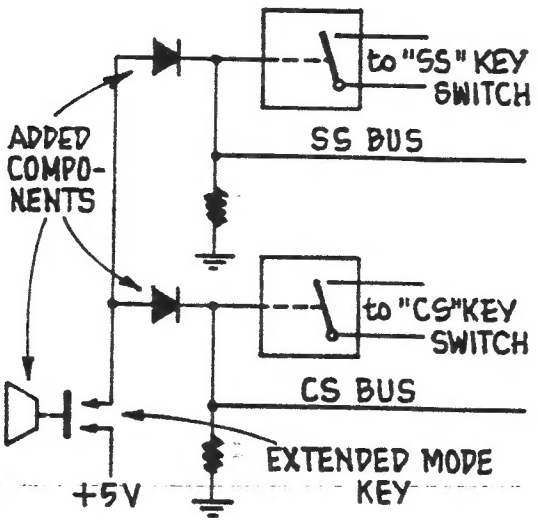


FIGURE 8

The diodes shown in the schematic are again needed for isolation; if the SS-bus is activated (pulled HIGH) by for instance pressing the dedicated ?-key, the CS-bus will not be affected, and vice versa.

The solid state switch comes packaged in a 16-pin DIP, four independent switches in a package. There are two types, the CD4016B and the CD4066B; their differences are of no concern in our application. Radio Shack sells the 4066 as their item 276-2466, current price $1.19. +5 V is plenty to supply and drive these IC's and the current drain is so small, that you don't have to worry about overloading your computer's power supply.

In our next article in this series, I will give you some points to consider on keytops, as well as some matters of concern.

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HOW ACCURATE IS YOUR COMPUTER ????

COMPUTE!'s Gazette, a magazine for Commodore computer users, recently had an irate letter to the Editor in it, part of which reads as follows: The letter writer was ready to buy an Apple; but that computer would show the same erroneous answer. The IBM PC and the IBM AT both yield: -3.360001. Even in their "double precision mode", the answer is STILL not correct: -3.3600000000000003! AND OUR LOWLY TI 2068? IT SHOWS THE ONLY CORRECT ANSWER: - 3.36 !!!

I was talking to another TI 2068 owner who said that it has a problem with simple subtraction:

PRINT 178.56−181.92
−3.35999997

---Cedric---

ALABAMA

North Alabama ZX 81 U.G./Bob Boyer/1010 Coronado Ave./Huntsville,AL. 35802/Tel. (205)883-4354

ALASKA

Alaska Sinclair User Group/3700 Cope St./Anchorage,AK./Tel.(907)276-4159

ARIZONA

First Sinclair User Group of Phoenix,Moshe Haraff/821 W.Marshall Ave./ Phoenix,AZ.85013

CALIFORNIA

Bakersfield Timex User Group/2617 Anza St./Bakersfield,CA 93305-3109

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Peninsula U.G./263 Gateway #107/Pacifica,CA 94044 Tel(415)359-1198

Sacramento U.G./Jim Hirleman/3665 Sunset Blvd.#98,Rocklin,CA95677

San Diego T.S.U.G./89 Oakland Ave./Chula Vista,CA.92011

Silicon Valley S.T.U.G./P.O.Box 4133/Santa Clara,CA.95054-0133/Tel (408)738-2888 ext 4579

South Bay Computer Club/2016 Walnut Ave./Manhattan Beach,CA.90266

Timex ZX80 U.G./1624 Loughborough/Merced,CA.95340/Tel(209)383-2464

West Los Angeles ZX81 U.G./P.O.Box 34545,Los Angeles,CA.90034

ZX81/TS1000 Users/P.O.Box 2411/Vista,CA.92083

COLORADO

T.S.U.G.Mile High Chapter/914 S.Victor Way/Aurora,CO.80012

CONNECTICUT

New Haven Sinclair Study Group/16 Lewis St./New Haven,CT.06501

S.T.Users/1070 S.Colony Rd./Wallingford,CT.06492

FLORIDA

Gainesville T.U.G/3224 Northwest 30thAVE./Gainesville,FL.32605/Tel (904)378-9000

Northeast Fla.T.S.U.G./1707 King St./Jacksonville,FL.32204

S./T.Southeast Region Club/869 Lovitt Pkwy./Rockledge,FL.32955

So.Fla.T/S.U.G./Mal Berry/9163 San Ct./Lake Park,FL./33410/Tel (305) 626-9194

So.Fla.ZX U.G./P.O.Box 057381/West Palm Beach,FL.33405

Timex-Sinclair Bay Area Microcomputer U.G./P.O.Box 644/Safety Harbor,FL 33572

T.S.Computer Club of Central Fla./808 E.Anderson St./Orlando,FL.32801

T.S.Technologies U.G./Jose Moreno/11331 S.W.4th St./Miami,FL.33165

South Fla.ZX U.G./P.O.Box 950/Boynton Beach,FL.33425-0951 BBS(305)[illegible]

ZX Timex U.G./950 Cynthia Dr./Titusville,FL/32780

GEORGIA

T.U.G.of Marietta,GA/3105 Mary Dr.N.E./Marietta,GA 30066

ILLINOIS

Circle Chess T.U.G./Box 61/Des Plaines,IL 60017

Sinclair User's Network/2170 Oak Brook Circle/Palatine,IL 60067

ZX Starter Kit U.G./6000 Puffer Rd./Downers Grove,IL 60516

INDIANA

Center Computer Organization/John A.O'Malley/P.O.Box6031/South Bend,IN. 46660/Tel.(219)288-0980

Timex 1000 Nat. Software Exch./Greg Gunthorp/RR2 Box 162,La Grange,IN 46761

KENTUCKY

Portsmouth T/S U.G./RE 63/Box 650/Greenup,KY.

LOUISIANA

[illegible]

MARYLAND

Capitol Area T.S.U.G./P.O.Box 725/Blacksburg,MD 20710 Tel.(301)922-0767

Seabrook-Lanham S.U.G./Cora C.Dickinson/9528 Elvin Lane/Lanham,MD 20706

Westinghouse T.S.U.G./Jack Fogarty/Westinghouse MS 3525/P.O.Box 1521/ Baltimore,MD 21203

MASSACHUSETTES

T.F.R.C./8 Eliot St/Cambridge,MA 02138

TSUG of the Boston Computer Soc./384 Great Rd.AptD-8/ Acton, MA 01720

MICHIGAN

Data Enhancement Berrien Users Group/Herbert Edwards/ P.O.Box 196/Berrien Springs,MI.49103 Tel.(616)471-1882

MISSOURI

TSUG of Greater Kansas City/Carl Mutch, Jr./4701 N.E. Linden Rd. #./Kansas City,MO.64151 Tel(816)587-8820

NEBRASKA

Sinclair Users Network(SUN)/Patrick Murphy/4903 Walker/ Lincoln,NE.68504 Tel.(402)464-8086

NEVADA

TUG of Las Vegas/Sven J.Nilsson/2405 Howard Dr./Las Vegas, NV 89104

NEW JERSEY

Cumberland County Area T/S Users/Jerry Sweet/110 N.6th St. Millville, N.J. 08332 Tel.(609)825-7119

Morris County TUG/Forrest Ct./Morris Plains,N.J.07950

NEW MEXICO

T-S Amateur Radio UG/Alex Burr/2025 O'Donnell Dr./Las Cruces,NM 88001

NEW YORK

Greater Metropolitan Club of the USA/Box 560/Wall Street Station/New York,N.Y.10005

[illegible](Long Island Sinclair Timex)Group/ P.O. Box 328 Centreport,N.Y. 11721-0328

Sinclair Computer User Society(SINCUS)/P.O.BOX 36/ Johnson City,N.Y.13790

S.Computer U Soc.(SINCUS)/P.O.BOX523/Owego,N.Y..13827

Sinclair Times/c/o Village Computers/687 Broadway/New York, N.Y.

T/S Users of America/Michael A Wilson/626 Water St./New York,N.Y.10002 Tel.(212)227-6570

T/S Users Club of Western New York/188 St Felix Ave./ Cheektowaga,N.Y.14227

TSUG/Mark Tepper/67 N.Main St./Geneva,N.Y.14456

Upperstate New York ZX81 Users/Vern Olsen/13 Dennis Ave./ Plattsburg, N.Y.12901

ZX UG of New York/Caroline Vivanco/P.O.BOX 560/Wall St. New York,N.Y. 10005 Tel.(212)866-7563 (other computers)

NORTH CAROLINA

TUG/Rt.3 Box 64E/Robinsville,N.C. 28771

Triangle SUG/ Doug Dewey/206 James St./Carrboro,N.C.27510

OHIO

Greater Cleveland Area SUG/6514 Bradley Ave./Parma,OH 44129

Timex P.O.R.T.S.(Portsmouth Ohio Region TSUG)/2002 Summit St./Portsmouth,OH.45662

TSUG/4255 South Hamilton/Columbus,OH

OKLAHOMA

TSUG/Bill Casebeer/P.O.Box 372/Oologah, OK 74053

OREGON

Clackamas County TSUG/14198 7th St./Oregon City,OR 97045

PENNSYLVANIA

Cannonburg's Color Computer Club/T.S.Group/R.[illegible] Virginia Dr./Donora,PA 15033

Central Penn. TS Comp. UG/Robert Neil/1525 N.Ashwicken Ct./ State College, PA 16801

Pittsburg Area Comp.Club/TSUG/Ed Mihalo/152 Deerfield Dr./ Pittsburg,PA 15235

TUG-DC/1109 Madison Ave./Prospect Park,PA 19076

SOUTH CAROLINA

TSUG Charleston/Larry Joye/4735 Spruce St./N.Charleston, SC 29406

Chattanooga Area Sinclair Users/Dan Williams/P.O.Box 1321/ Collegedale,TN 37315

TUG/1501-B Compton Ave./Nashville,TN 37212

TEXAS

Abilene TSUG/Chris Nystrom/ 609 EN 18th ST, Abilene,TX 79601

Timex Educators UG/Mark Wasicsko/ School of Education/ Texas Wesleyan Col./Ft.Worth,TX 76105

San Antonio TSG/Jim Houston/414 W.Elmore Pl./San Antonio, TX 78212

TSUG/Joe Jenkins/3100 Mockingbird/Amarillo,TX 79109

TSUG of Fort Worth/David Baulch/4424 Geddes Ave./Ft.Worth TX 76107

VIRGINIA

Colonial Pennwild TSUG/Jim Langston/146 Hawthorne Dr./ Newport News,VA 23602 Tel.(804)877-3920

Southern Vir.Timex Users Network/Gary Preston II/Route 1 Box21/Glade Hill,VA 24092

WASHINGTON

Seattle Area TUG/Apt 350/3501-88 S.E.Mercer Island,WA 98040 Tel.(206)236-0470

WASH.,D.C.

Washington Area UG,Timex/Steve Wyett/P.O.Box 6239/Wash.DC 20015 Tel.(903)920-3710

WISCONSEN

Sinclair Milwaukee U.G./P.O.Box 101/Butler,WI 53007

ALBERTA

Calgary TSUG/Box 201/Station G/Calgary, Alberta T3A2G2

BRITISH COLUMBIA

TSUG of Vancouver/P.O.Box 788/New Westminister,B.C. B3L 4X8

Vancouver SUG Network/Rod Humphreys/2006 Highview Pl./ Port Moody,B.C. V3H 1N5 CANADA

ONTARIO

Toronto TSUG/P.O.Box 7274, Station A/Toronto,Ontario M5W 1X9 CANADA

QUEBEC

TSUG, Ottawa Chap./B.Mulder/648 Jeanleese St./Gatineau, Quebec J8R 1N1

[illegible]

64 BULLETS BBS Jackson Heights NY 718 779 3760 *24
EARTH NEWS CENTRAL 718 934 0774 1200 Baud *24
KENNEDY AIRPORT Brooklyn NY 718 963 2189 *24
NYC LIVE ABBS New York City NY 718 963-2189 *24
PRO-TO-CALL, IBM PC BBS Far Rockaway NY 1200 baud 718 471 2436 *24
PUNTER BBS Jackson Heights NY 718 779 3760 *24
SANTO BBS of 718 596 5862
ZAP'S DINNER Brooklyn NY [illegible] 645 0646 300 baud *24
ZEBRA [illegible]

[illegible] 5966

Reprinted from the April 1986 LIST

KEYBOARD MANIA — Part 3

By Cedric R. Bastiaans ©

IX. FITTING THE TI-99/4A KEYBOARD INTO THE TS 2068 CASE

The TI keyboard which flooded the market after the demise of the TI computer, offers a fine opportunity for you to try your hand at putting a full-travel keyboard to work for one of the finest computers around.

> But first a word of warning: Neither LIST nor I can be held responsible for any damage resulting from these proceedings. Once you open up your computer, you are on your own, voiding all warrantees, if any.

Also, if changing a light bulb means a major endeavour for you, maybe you should not attempt any of the following...

IX.1 WHICH KEYBOARD?

I know of at least two versions. THE FOLLOWING PROCEDURES ARE ONLY FOR ONE OF THEM! It may be that the other version lends itself to a like modification. But for now, I can only address myself to one item at a time.

The versions in question are (and I am putting the corresponding deviations for the WRONG version in parentheses):

Black keys with white legends (beige keys with grey).
Keys are a trifle hard to remove (easily removable).
Key switches are only numbered 1 through 48 (alpha-numerically indicated)
15-pin ribbon cable connector is numbered 1 thru 15, R to L (not numbered).
The PCB identifications are 1039019-1 (1039019-3), made in Japan (Korea), there is no TI-logo (there is), 94 V-0 (same), made by ALPS (by SE-JIN).

In addition, the PCB TRACES ARE TOTALLY DIFFERENT!
Also, it appears that the Alpha Lock key is not always a Push/Push type. You're in luck if it isn't (see later).

A dead give away is the fact that my keyboard has a RECESSED PCB, in contrast to the other one which has one which is very close to the mounting flanges

The TI keyboard can still be purchased from the Arnold Co. (new for $5.99 + $3 shipping), 214 Hill Lane, Red Oak TX 75154 or from the LOLIR LECTRONICS CORP. (surplus for $3.75 + $3.50 shipping), 13933 N. Central Expressway, suite 212, Dallas TX 75243. If you want to order, I suggest you specifically ask for the ALPS keyboard.

Once again, it may be possible to modify the TS 2068 to accept the other KB. If there is enough interest, I just might endeavour to look into it. Write me c/o LIST. (See Note at the end of this article).

IX.2 THE TI MATRIX

The TI matrix is shown in Figure 9. Note that I have labeled the KBD and the A-lines as 1T, 2T etc. This to avoid confusion with the TS 2068 matrix.
At first glance there appears to be a similarity between it and the TS 2068. Aside from the obvious deviations in the 8 keys , . / ; = CNTL FCTN and Alpha Lock, there is a major problem in that the entire bottom row is shifted over one key!

But fear not, we can lick it. Let's first discuss what to do with the dedicated key functions. It should be obvious that there is no room for such elaborate IC functions as described in Chapter VII of Part 2 of this series. But there remain

some useful ones, such as the comma, the period, the colon, the semi-colon and Delete key. In addition, I suggest that you use TWO Symbol Shift keys, one on e side of the Keyboard. Then there is the Alpha Lock; we could wire it simply parallel with the Caps Shift keys. But this has limited usefulness; it is NOT t same as Caps Shift 2, a TRUE caps shift. In contrast, the Alpha Lock does not

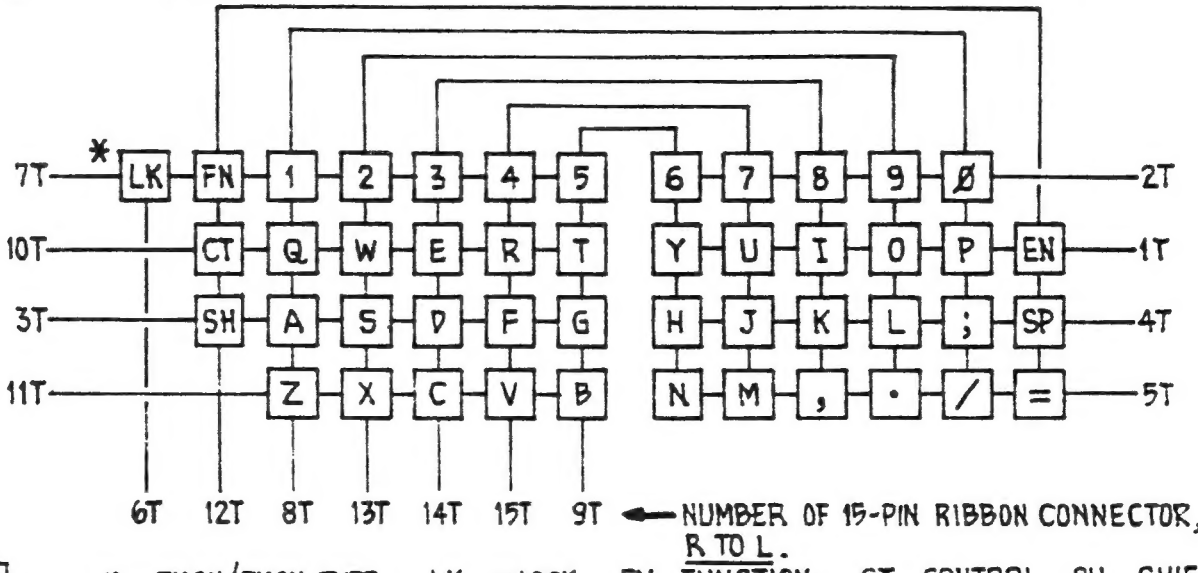


FIGURE 9 * = PUSH/PUSH TYPE LK = CLOCK FN = FUNCTION CT = CONTROL SH = SHIFT

allow the punctuation marks to work, nor the numbers, nor the Symbol Shift. It is only useful with the cursor keys and of course the letters.
That's why I elected to use the Alpha Lock key as an asterisk key, to use with the Zebra Disk Drive. One just has to get used to operating it in a quick Push/Push fashion, so as not to cause it to go into a continuous repetition of the character! I have tried in vain, to modify this key. I leave it up to the reader to do with it as he or she sees fit. No further reference will be made to this key, not even as an asterisk key!

IX.3 THE MODIFIED TI MATRIX

Figure 10 shows the TI keyboard as we would want it to be. Quite obviously, the dedicated keys are:

Key Switch 11, for the DELETE key
Key Switch 22, for the COLON key
Key Switch 46 and 48, for the SYMBOL SHIFT keys
Key Switch 32, 42 and 43 for the SEMICOLON, COMMA and PERIOD keys

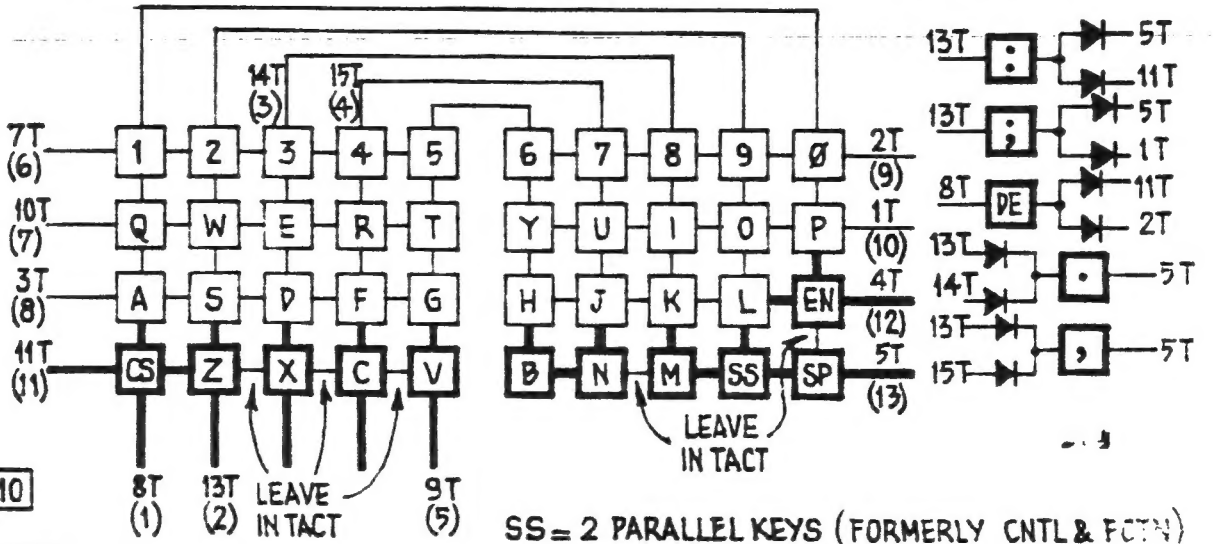


FIGURE 10

NOTE:

M = NEW KEY, WITH EXISTING LINE AND A NEW LINE

SS = 2 PARALLEL KEYS (FORMERLY CNTL & FCTN)
: = FORMERLY /-KEY
DE = FORMERLY =-KEY

This seems like a good time to list all the keys, as we have now defined it:

Switch #	Key	Switch #	Key	Switch #	Key	Switch #	Key
1	1	13	W	25	D	37	C
2	2	14	E	26	F	38	V
3	3	15	R	27	G	39	B
4	4	16	T	28	H	40	N
5	5	17	Y	29	J	41	M
6	6	18	U	30	K	42	,
7	7	19	I	31	L	43	.
8	8	20	O	32	;	44	CS
9	9	21	P	33	EN	45	OPTION
10	0	22	:	34	CS	46	SS
11	DE	23	A	35	Z	47	SP
12	Q	24	S	36	X	48	SS

IX.4 CUTTING THE TRACES

We are now ready to cut into the PCB. If you own a Dremel Moto-Tool kit or the like, you'll be done in no time. But otherwise, an X-acto knife with a No.11 blade will do just fine, even if it takes a little longer.

The following list will take you step by step; put the PCB with the 15-pin connector on top, traces of course towards you.
If you're ordered to cut a trace, draw the X-acto knife towards you, taking care not to inadvertantly cut adjacent traces. You may find that an additional cut or two may help. Now, move the X-acto blade over about 1/16th of an inch and repeat. Next, gently pry the thusly cut trace away, see Figure 11.
Don't be afraid, there is really nothing to it. And if you find that you cut the wrong trace, don't despair. It is always possible to put a jumper back to where you erroneously cut the trace. But why not try to avoid errors all together?

On Switch 45 (LK), cut BOTH traces close to the solderpads.
On Switch 11 (=), cut BOTTOM trace close to pad, UPPER trace on both sides.
On Switch 32 (;), cut trace close to TOP pad.
On Switch 22 (/), cut TOP trace next to pad, BOTTOM trace ONLY to the right of it!
On Switch 42 (,), cut traces on both sides of BOTTOM pad.
On Switch 43 (.), cut trace to BOTTOM pad. Careful! Don't cut the major trace; just the small portion connecting to the pad!
On Switch 35 (Z), cut BOTTOM trace between it and BOTTOM of 23.
On Switch 36 (X), cut trace close to BOTTOM pad.
On Switch 37 (C), do the same for the BOTTOM pad.
On Switch 38 (V), do the same with the BOTTOM pad.
On Switch 39 (B), cut the trace close to the TOP pad.
On Switch 40 (N), cut trace to BOTTOM pad.
On Switch 41 (M), cut traces on both sides of BOTTOM pad.
On Switch 47 (SP), cut the trace to the LEFT pad.
On Switch 48 (FCTN), cut the traces to BOTH pads.
On Switch 46 (CNTL), cut the traces to BOTH pads.
On Switch 33 (EN), cut the trace to the TOP pad.
On Switch 34 (CS), cut the trace to the TOP pad.

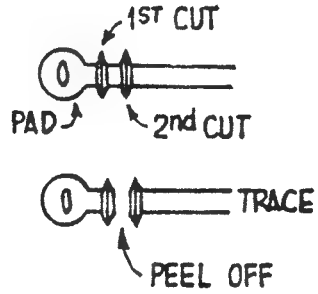


FIGURE 11

This was it, as far as cutting traces is concerned. The next installment will instruct you to make several jumpers and we will also cut into the TS 2068 case!

Note: ---oooOOOooo---

The Author is pleased to announce that he has found a way to put the Korean-made SE-JIN keyboard into the TS 2068 case! The Japanese-made ALPS keyboard is STILL to be preferred, though. See the upcoming installments in this Keyboard Mania series...

IMPROVING THE ZEBRA GRAPHICS TABLET

Users of the Zebra Graphics Tablet will have no doubt noticed the annoying behavior that I will term "Spray". If you don't press the stylus against the tablet very firmly, you get a wild spray of dots.

You may have also noticed that the "Spray" tends to be directed towards the center of the tablet. This is because there are a pair of centering resistors which cause tablet readings to return to center when there is no contact with the tablet. The "Spray" phenomena is essentially micro seperations of stylus contact. The duration of these micro seperations is very short but the cursor instantly centers on each seperation event, causing the "Spray".

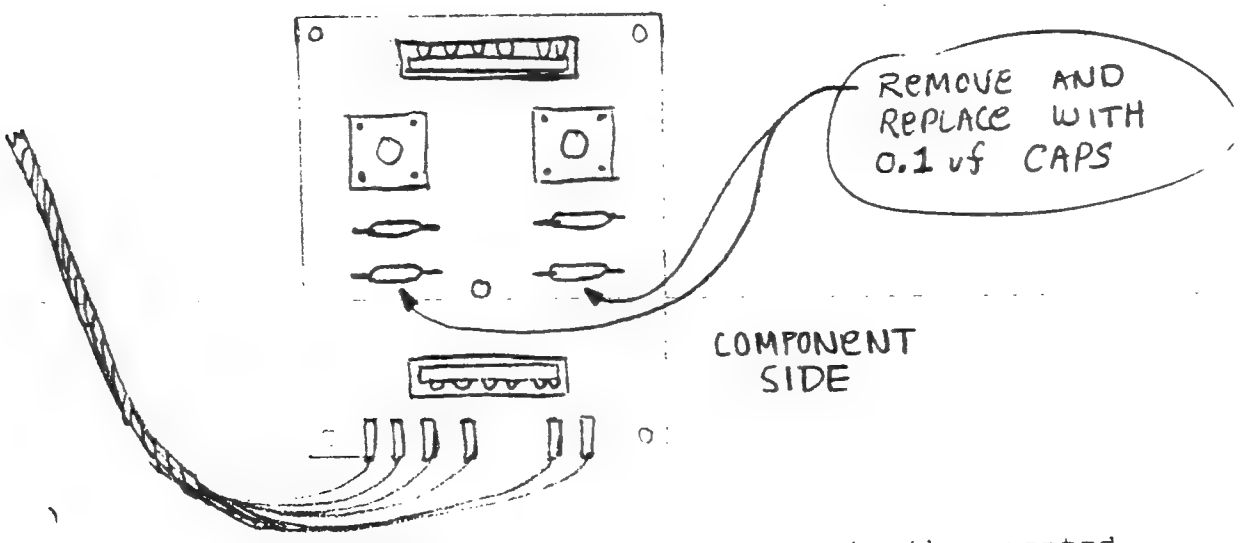
By eliminating the instant centering of the tablet you will be elimating the "Spray" phenomena. You can do this by removing two resistors and replacing them with 0.1 uf capacitors. To do this follow the instructions below ...

1) Place the tablet upside down and remove seven screws.

2) Carefully seperate bottom of tablet from top. Unplug two connections from the pc board inside.

3) Unscrew pc board from bottom of the tablet.

4) Desolder the two resistors indicated in the diagram below.



5) Solder two <u>0.1 uf ceramic disc capacitors</u> into the vacated resistor locations.

... put the tablet back together (this may be a bit tricky) and try it out. You will notice a significant improvement in performance.

Reprinted from the May 1986 LIST

KEYBOARD MANIA — Part 4

By Cedric R. Bastiaans©

NOTE :
The previous installment ended with a note to the effect that I had also found a way to put the Korean SE-JIN version of the TI 99/4A keyboard in the TS 2068 case.
Please be advised, though, that the Japanese version by ALPS is STILL preferred! The black keys look better on the silver computer case but more importantly, the tactile feel is much better. But most of you, who for many years have suffered the pain of inadequate keyboards by Uncle Clive and Timex, might not note any difference and think that the SE-JIN keyboard is "heaven"!
The following is ONLY for the ALPS keyboard; I will give the modifications for the SE-JIN KB in a separate installment of KeyBoard Mania.

IX.5 PUTTING IN THE JUMPERS

We are now ready to put in jumpers. I suggest you use Wire Wrap hookup wire, I prefer to use 26-Gauge wire, but it is perfectly allright to use the more common 30-Gauge. This so-called Kynar wire is a joy to work with because it does not have the nasty habit of Vinyl wire creeping away on you when heat is applied.

The first thing to do, is to put a 1-pin terminal on the board. Get a STRAIGHT SINGLE-ROW MALE HEADER STRIP, typically measuring .510 inch overall. They come in rows of 36 pins and measure .100 " center to center. Radio Shack does not carry them, but most other electronic stores do.

Break off one such header pin and you have a 1-pin terminal, which you can attach with a bit of Epoxy on the PCB, in the LEFT TOP corner area between the traces SOUTH WEST of the bottom pad of Switch 10. (The remaining header pins will be used later on).
In the following, "LEFT", "TOP" and "BOTTOM" again refer to solderpads of keyswitches.

Jumper from BOTTOM 22 (/) to BOTTOM 20 (0).
Jumper from BOTTOM 25 (D) to BOTTOM 30 (K).
Jumper from BOTTOM 26 (F) to BOTTOM 29 (J).
Jumper from BOTTOM 23 (A) to BOTTOM 34 (CS).
Jumper from TOP 34 (CS) to TOP 35 (Z).
Jumper from BOTTOM 35 (Z) to BOTTOM 24 (S).
Jumper from BOTTOM 36 (X) to BOTTOM 25 (D).
Jumper from BOTTOM 37 (C) to BOTTOM 26 (F).
Jumper from BOTTOM 38 (V) to BOTTOM 27 (G).
Jumper from TOP 39 (B) to TOP 40 (N).
Jumper from BOTTOM 40 (N) to BOTTOM 29 (J).
Jumper from BOTTOM 41 (M) to BOTTOM 30 (K).
Jumper from BOTTOM 46 (CTL) to BOTTOM 48 (FCTN) to BOTTOM 31 (L).
Jumper from TOP 46 (CTL) to TOP 48 (FCTN) to TOP 42 (,).
Jumper from TOP 33 (EN) to TOP 31 (L).
Jumper from LEFT 47 (SP) to TOP 41 (M).
Jumper from TOP 11 (=) to BOTTOM 10 (0).
Jumper from 1-pin terminal to TOP 38 (V).

IX.6 ADDING THE DEDICATED KEY FUNCTIONS

We will be using either 1N914 or 1N4148 diodes to implement the functions. A word of caution: I have at least once purchased signal diodes from Radio Shack, that had their pigtails severely curtailed, 1" instead of the standard 2". You will need the full 2" length in some of the following.

Put all diodes FLAT against the PCB; I have found no need for insulation, but be careful with this. Avoid shorts!

PERIOD key, switch 43.
Connect two diodes, from BOTTOM 31 (L) and BOTTOM 41 (M), to BOTTOM 43 (banded sides towards 43).
COMMA key, switch 42.
Connect two diodes, from BOTTOM 20 (O) and BOTTOM 18 (U), to BOTTOM 42 (banded sides towards 42).
COLON key, switch 22.
Connect two diodes (unbanded sides towards TOP 22), one to the pad immediately to the right of it and the other going to the 1-pin terminal.
SEMICOLON key, switch 32.
Connect two diodes (unbanded sides towards TOP 32), one to TOP 21 (P), the other to the pad immediately NORTH NORTH WEST of 32.
DELETE key, switch 11.
Connect two diodes (unbanded sides towards BOTTOM 11), one to TOP 10 (0), the other to the 1-pin terminal.

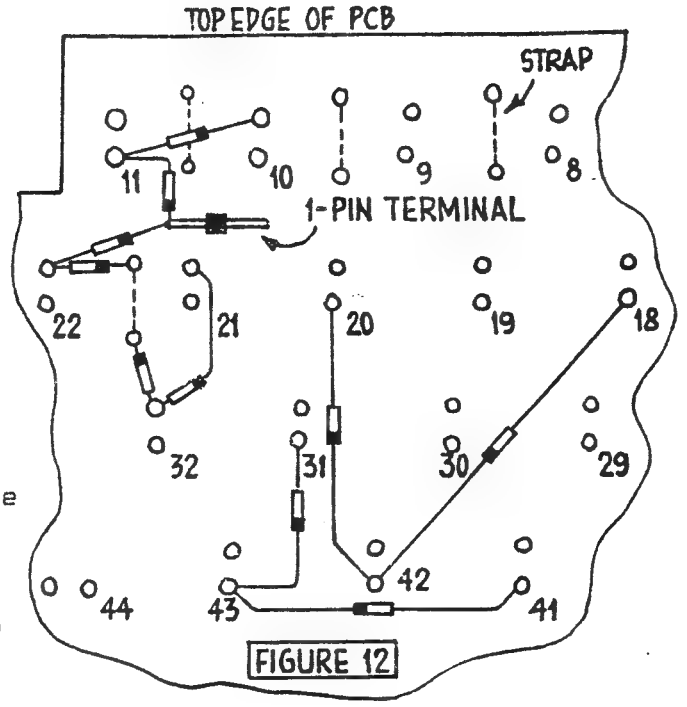


FIGURE 12

You need not be confused, because I prepared Figure 12 especially for you, to guide you along!

As I mentioned before, I leave the function for the Alpha Lock Key up to you. If you have read the preceding articles, you should have no problem implementing the necessary components for whatever function you dedicate this key to.

IX.7 CHECKING OUT THE PRINTED CIRCUIT BOARD
You may already have noticed that pins 6T and 12T on the connector are not used anymore; they have been severed during the trace cutting operation.

Now is the time to check your handiwork.
Break off a strip of 15 HEADER pins and insert this into the ribbon cable connector. Note that you have in effect, made it into a MALE connector!
Next, get yourself an OHM-meter or a continuity tester and check out the ENTIRE matrix as per the modified matrix of Figure 10 (Part 3). For instance: connect the leads of your tester to pins 8T and 11T of the connector, remembering that the pin numbering is from Right to Left, when looking at the printed circuit board, with the connector on top. Pressing either one of the two CapShift keys should produce a very low reading, close to zero ohms or a beep from the continuity tester. Check ALL the remaining keys; none should give you the same result! If there is a problem, you should carefully check the trace cuts and jumpers. Apply this procedure to all keys and their matrix coordinates. This may sound like a time-consuming affair, but it really is not and it pays off to get an early warning of anything that might have gone wrong in the preceding modifications.

Also check out the dedicated key functions, bearing in mind that the current flows from KBD to A-lines; observe the polarity of your test leads!
Correct anything that's not in order.

If you found everything to be in good order; CONGRATULATIONS! You have obviously done a good job and you're half-way into this project!

IX.8 FINISHING THE RIBBON CABLE
What's left to do is the interface with the J-9 connector of the computer board.
Remove a 14-pin section from the HEADER strip (you're done with the remainder).

Get a 5-inch length of 13-wire ribbon cable (pin 0, ground, of J-9 will not be connected), and wire this between the 14-pin and the 15-pin header strips, according to the "twistor" of Figure 13.

TI	J-9	TI	J-9	TI	J-9	TI	J-9	TI	J-9
1T	10	4T	12	7T	6	10T	7	13T	2
2T	9	5T	13	8T	1	11T	11	14T	3
3T	8	6T	N/C	9T	5	12T	N/C	15T	4

FIGURE 13

I suggest that you keep the 13-wire ribbon cable straight and neatly connected to the 14-pin header strip at the computer end, and TWIST it near the 15-pin header, which you already inserted in the 15-pin TI connector.
Also, make sure that you align the ribbon cable such that the "connector" (=14-pin header) has its #0 pin on its extreme LEFT, while you have the keyboard positioned with the keys UP and its connector (=15-pin header) towards the top.

Check your connections with your tester; make sure that you have no solder bridges between the pins! Then wrap some electrician's tape across the soldered ends of the header strips. Temporarily set the keyboard aside.

IX.9 CHECKING OUT THE KEYBOARD

Take your TS 2068 computer and turn it bottom side up. Unscrew the seven sheetmetal screws. Notice that three of these screws are longer; they are for the rearmost holes. Turn over the case and lift up the lid with its keyboard (it doesn't go all the way). Reach under the lid and carefully remove the 14-conductor ribbon cable from connector J-9. Temporarily put the lid aside.

Now, take the modified TI KB and position it immediately above the bottom part of the computer case, with its keys down, the PCB facing up, the 15-pin connector towards you. You will find that contrary to the Timex KB, your new KB has enough ribbon cable to comfortably reach the J-9 connector.
Carefully insert the 14-pin header into J-9 (remember: pin #0, on the extreme left, is NOT connected, but we provided a dummy pin for proper alignment of the header connector).

You are now ready to apply power to the computer; don't connect any peripherals, except for the monitor or TV. If everything checked out before, you should find that the new keyboard should work properly! To check this out, you can lift the keyboard on its "rear-end" allowing you to press the keys.

If you're satisfied, you should now proceed to modify the computer top. Unplug the computer; disconnect the KB and put both in a safe place.

IX.10 MODIFICATION OF THE TS 2068 CASE

Retrieve the lid and notice the overlay with all the Extended Mode legends and the indication "PERSONAL COLOR COMPUTER" on the bottom, left of the space bar. We are going to remove this. We do this by CAREFULLY prying up the left lower corner of this overlay, using a small knife with a DULL point. Work your way around; it is possible to do this without undue damage to the overlay, although as far as I'm concerned, it has done its job and should be thrown out! But remember, I'm the maniac and am therefore thoroughly biased! YOU might want to keep it.

Next we notice five Phillips screw heads. Remove these, turn over the lid and the TS 2068 keyboard will fall out. Donate it, together with the overlay, to the local Sinclair/Timex Museum Annex.
Seriously, should you ever decide to put the original TS 2068 keyboard back in place, you may rest assured that INDEED YOU CAN!

Now, remove the 2 grounding clips; we won't use them. Also, snip off the two plastic studs that stick up from the bottom of the lid.

Next comes a bit of sawing, cutting or milling. Study Figure 14; notice the 3 cutouts, depicted in black. You can make these in a variety of ways. By far the easiest is probably SAWING. Use a coping saw with .020" saw blades or use a jeweler's saw. In the latter case, however, be advised that very fine blades need COOLING! Polystyrene, the stuff of which our computer case is made, has a very low melting temperature. The heat created by sawing causes the kerf to melt together again, right behind the saw blade, causing it to bind! I therefore advise you to either use .020" blades or use water as a coolant.

You can also use a milling machine if you have access to one. Or use a Dremel Moto-Tool. Either way, just remember that Cuts # 2 and 3 should really be cutouts, whereas Cut #1 need not go all the way through the bottom (you have a choice of milling or "Dremeling" down to the bottom or cutting through). Take your time; notice the sides of the two cutouts that follow the contour of the overlay recess. These have to be cut with some degree of accuracy; the remaining sides are not so critical.
If you're going to saw, I suggest that you drill holes in each corner of a cutout, to facilitate insertion and turning of the saw blade. Remove burrs with a file.

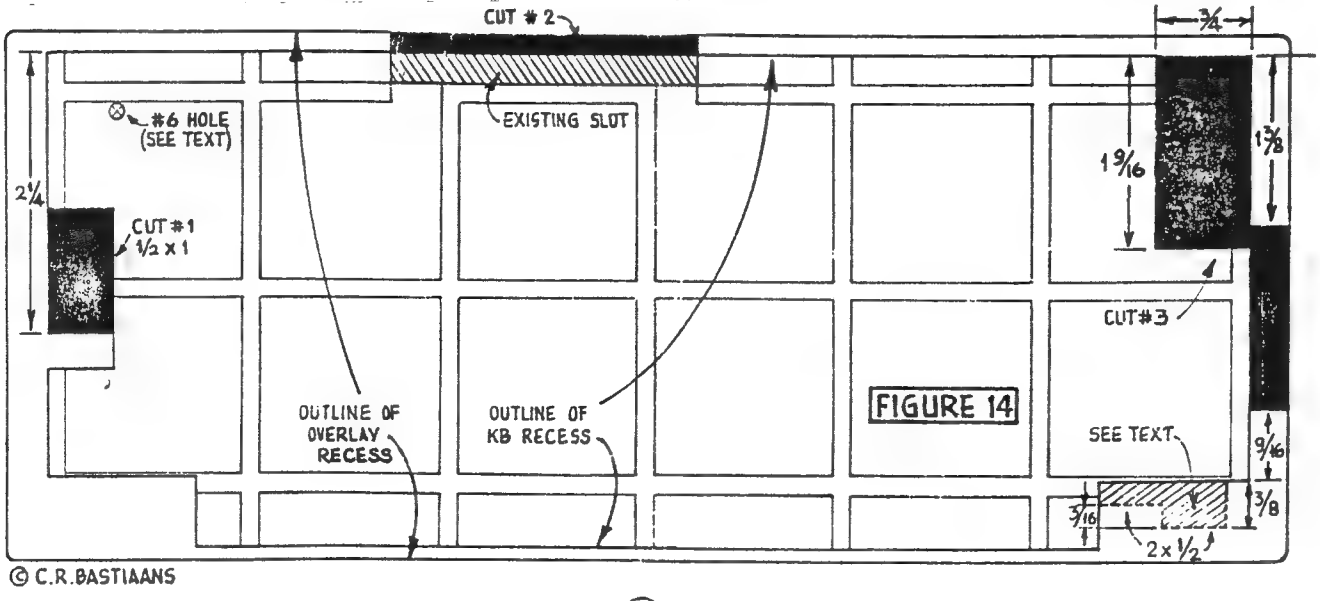
Next, you have to file and maybe countersink the area in the lower right corner; this is to clear some of the protrusions of the PCB connections of Switch 48.

Take your modified TI keyboard, slip the ribbon cable through Cutout #2 and ease it into the modified keyboard recess. You do this by inserting the right-hand portion into cutout #3 first and then dropping the left-hand portion into the recess, moving the keyboard as far to the right as possible. It should sit flush with its PCB right on top of the computer case. Neat, huh?

Take a marker and mark the top hole in the left-hand mounting flange. Drill a #6 hole in the bottom of the lid, use #6 hardware but invert the #6 screw, so that the nut is inside the lid. If you're satisfied with the alignment, put a little Epoxy around the nut onto the metal flange (NOT on the threads!) and you will not have to worry about ever losing the nut inside the lid.

Finally, fold a small piece of stiff cardboard or fish paper and wedge it between the right-hand mounting flange of the TI KB and the TS 2068 case. The KB is firmly held.

Next installment will disclose a neat way of making keytops for the TS 2068.



Reprinted from the June 1986 LIST

KEYBOARD MANIA — Part 5

By Cedric R. Bastiaans ©

NOTE 1:
I encountered several problems with intermittent ribbon cable connections in the original TI cable of the TI-99/4A KB. From just one, to ten (!) out of the fifteen conductors! This is probably caused by these keyboards being surplus and therefore not packaged (= not protected) and thusly subject to a lot of abuse.
In hindsight it is therefore much better to REMOVE the original TI cable altogether, use a new 7-inch length of 13-conductor ribbon cable instead of the 5-inch one I recommended in paragraph IX.8 of Part 4. Then, do away with the 15-pin header strip and check out your modified circuit board directly against the solderpads 1 through 15. Solder the new ribbon cable directly to these pads, again using the "twistor" instructions of figure 13.

NOTE 2:
This installment will again address itself to keyboards in general. It will give you hints and tips on finishing your keyboards, either a large, multiple-key version or a modified TI-99/4A.

Details on the installation of the Korean-made (SE-JIN) TI keyboard (beige keys) will follow at a later date.
But I have again to voice my opinions about this version of that keyboard. I stress the point that the Japanese-made (ALPS) KB (black keys) is much to be preferred. Compared to it, the SE-JIN KB requires more PCB trace-cuts, more jumpers, has confusing, poorly executed keyswitch symbols making it VERY EASY to make mistakes in your modification efforts. In addition, though the physical modifications to the computer case are certainly not impossible to do for most of you, they're more involved.
Then there are some subjective considerations. I already gave you my impression of the tactile feel of the SE-JIN KB, but there is also the beige color of its key's. It's my considered, artistic opinion that BEIGE does not look good on SILVER!

X. HOUSING AND/OR FINISHING THE KEYBOARD

X.1 LARGE KEYBOARDS

It is imperative that you find yourself a suitable housing for the keyboard AND the computer board.
I think it's ludicrous to have your keyboard in a case separate from the computer case, like for instance the Memotech KB for the TS1000/ZX81. The Sinclair/Timex computer systems already suffer from the many piggy-backed add-ons they so often require; one doesn't need yet another, large-size add-on!

I have found a keyboard/computer case that is just perfect for our TS2068.
It is made by L M B, 2946 East 11th Street, Los Angeles, CA 90023 and it is their model KB-17 "The Keyboarder", measuring 7" deep x 17.25" wide x 3" high in the back and 1.5" in the front.
I do not know if L M B would accept mailorder or OTC purchases; I bought my case from ITC Electronics in LA. It is certainly worth finding out or otherwise have your favorite electronics store order one for you.

The LMB case is made in two U-shaped parts and had plenty of room for my TS2068 computer board, the two extra PCB's for dedicated key circuitry and the 77-key full travel keyboard (36 dedicated key functions!). Figure 15 is a photograph of the case, opened up to show its contents. The computer board is mounted on stand-offs, next to the leftmost and rearmost case walls.

I had to make several cuts in the case, which is made of aluminum and therefore easy to work with.

Cutouts were made in the lefthand wall, for the ON-OFF SWITCH, the DB-9 JOYSTICK PORT and I also made an opening for a SAVE/LOAD SWITCH.
In the rear are 5 cutouts for the POWER, TV, EAR, MIC and MONITOR receptacles as well as 2 more, for another DB-9 connector (RGB output) and for the EXPANSION PORT. The computer board needs careful alignment, to insure proper mechanical and electrical connection of peripherals to the expansion port.
The second joystick port is too far away from the righthand case wall and I have elected not to use it.I don't play shoot 'em-up games on my computer and consider one joystick port sufficient for any of my needs. If you do need the second port use a set of male/female DB-9 connectors and a short 9-conductor cable to make yourself an extension.

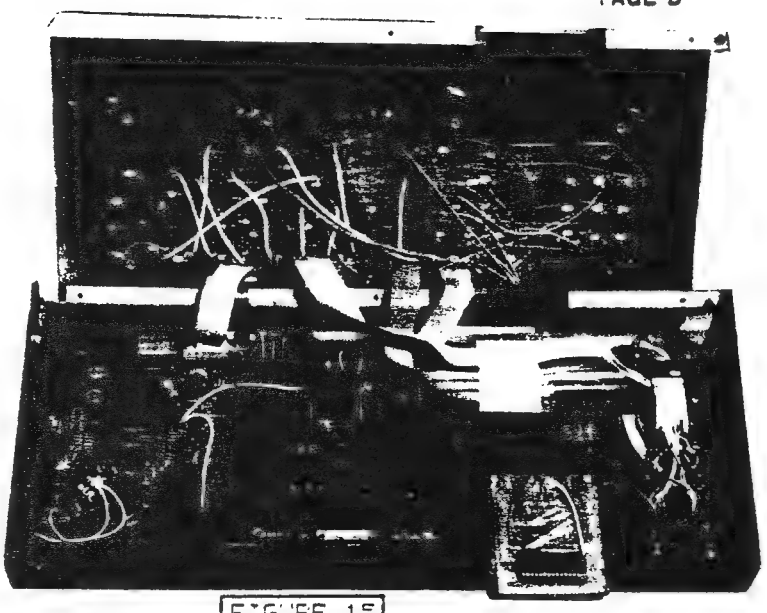


FIGURE 15

Then there is an opening in the bottom of the case for the little loudspeaker. I suggest you use something to protect the speaker here (I used a piece of perf-board).
The case top needs of course a cutout for the keyboard and I also added an opening for an LED AC power light.
There is no room nor is there a need for a lift-up door for the "COMMAND CARTRIDGE". Instead, I made an opening in the front wall and used plastic parts of the now expendable computer case to construct a proper loading ramp for the cartridges, Spectrum ROM emulators and such. The cartridge "disappears" completely into the case, when inserted, so it requires a "retrieval" loop tied to its handle. To prevent undue collection of dust, I cut the expansion port COVER to size, to fit the opening I made for the Command Cartridge port.

Since I also have leather craft and woodworking as other hobbies, it stood to reason that I would finish my computer case with genuine black morocco leather, while the endpieces are veneered with real Brazilian Rosewood.
I'm quite proud of this combination and since there is no TS2068 nor a Spectrum like it, I've dubbed it "SPECTRE 2086" and this logo is proudly displayed on the case, in dark-red letters and numerals, a 3-dimensional epoxy-cast, also a product of my own hand...

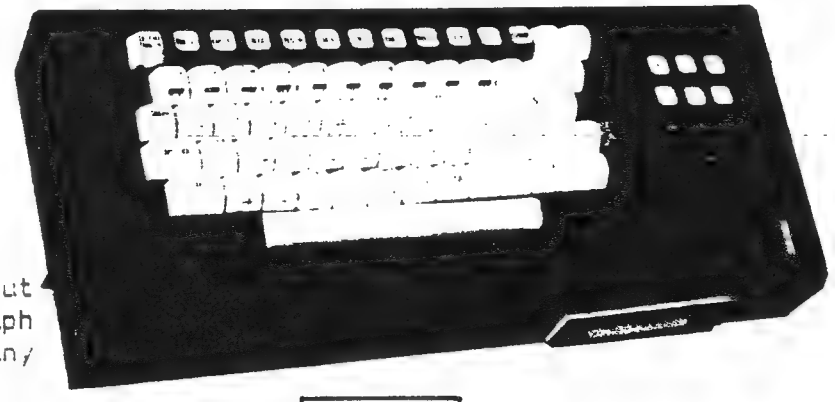


Figure 16 shows the Spectre 2086, but the xerographic copy of a photograph does not do this thing of beauty any justice!

FIGURE 16

X.2 THE TI-99/4A KEYBOARD
To pretty up the hardware project explained and detailed in Parts 3 and 4 of this series, I constructed a "mask" around the TI KB as it is mounted in the TS2068 case, using 1/8 inch BALSAWOOD, available in hobby shops.
Pieces of this wood can be very easily cut with our trusted #11 Xacto knife and glued to the metal frame-work of the TI KB with fast-curing epoxy. IT SHOULD NOT BE GLUED TO THE COMPUTER CASE! It can be made to cover the entire periphery around the keyboard and will still allow the removal of same...

The balsa mask is easily constructed; rounding appropriate corners should make it look quite pleasing. The wood is to be sealed with balsa filler coat (Aero Gloss 70-1, available in hobby shops) and sanded. Next, a coating with sanding sealer (Aero Gloss 71-1) and again sanded. A spray or two of quick-drying silver paint will give the case a very good-looking finish.

Figure 17 is a photograph of the final project. Doesn't it look neat?

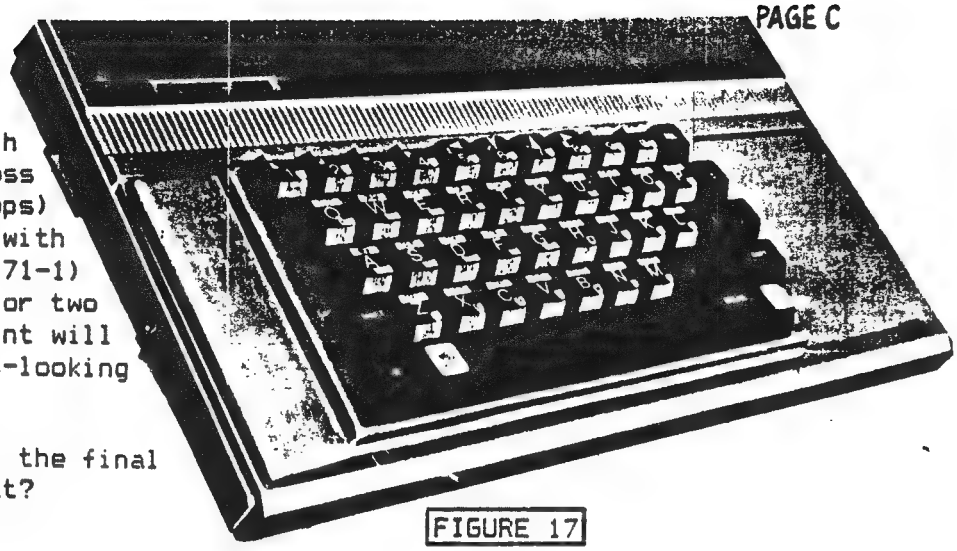


FIGURE 17

XI. THE KEYTOPS

Probably the most time-consuming job is the making of keytops. There is unfortunately no source for ready-made keytops, like there was in the days of the TS1000/ZX81 (Mule Electronics in the Los Angeles area).
I did see sheets of Spectrum keytops, printed on paper without any adhesive backing (how stupid!), but these are of such awful artistic quality, I would not wish them on the keyboards of my worst enemy! They also have rather GARISH red and green colors. I can not recommend them...
So what to do? I have to suggest two approaches to this problem.
But first, I need to discuss the next, related topic.

XI.1 KEYBOARD "MAKE-OVER"
Ever since I've been involved in constructing real keyboards for the TS2068, I've followed a particular philosophy and maybe I can get you to side with me. Bear in mind that we have no room around the keys, so that all legends need to find a place on the keys themselves.

XI.1.1 - Keytops should be COMPLETE.
This means that functions and commands, not shown on the original 2068 KB, should be included. I'm talking about CONTRAST (key 9), TRANSPARENT (key 8), the COPYRIGHT symbol © (key P) and the BRACES (keys F and G).

XI.1.2 - I think that the keytops should reflect the TRUTH
What this means then, is that the GRAPHIC SYMBOLS (keys 1 through 8) should be depicted like the resulting video image! In other words the black part on the keytop design should correspond with the black symbol on screen!

XI.1.3 - Keytops should be COLOR CODED.
All my keyboards show SYMBOL SHIFT in red letters on white keytops. The corresponding symbols on the various keys are likewise in red on white.
This makes for very easy recognition of these symbols, just like they were on the original ZX81/TS1000 keyboards.
On my 77-key KB, the EXTENDED MODE key is powder-blue, and the corresponding dedicated functions like READ, DATA, RESTORE etc. are black, but have a powder-blue top.
CAPS SHIFT is green on white, the corresponding shifted functions on the numerical keys 1 through 0 are also in green. The thought behind this is that these legends are to be put on the same line as the keywords on other keys and should therefore be differently indicated. Doesn't this make sense?
Fully color-coded keytops are only possible with transfer lettering, see paragraph XI.2.

XI.1.4 - TOKENIZED KEYWORDS are important commands and should therefore be prominently indicated on the keytops. Thusly I have made them the uppermost legends, whereas I have put the EXTENDED MODE functions together, on the front slope of the keys, with the standard EM on top and the additionally SHIFTED EM function immediately below it. I find that these functions are then so much easier to locate.

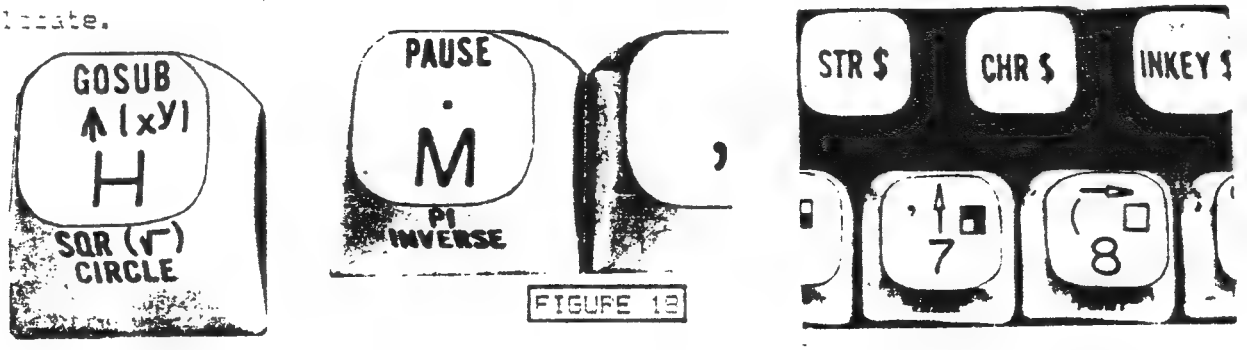


FIGURE 18

Figure 18 clarifies my intend; compare this with the corresponding keytops on the original TE2068 KB.
Then there are the additional color indications on keys 1 through 0 (BLUE through BLACK, including TRANSPARENT and CONTRAST on keys 9 and 9). These are to be put on the first line of the front key slope; on my large keyboard they are in white on a black background, to remind us that they are NOT EM-functions.

XI.1.5 - The ENTER key should be prominently marked and therefore be painted ALL RED, especially with the TI-99/4A keyboard, whose ENTER key is not any larger than the other keys, contrary to the norm.

XI.2 USING TRANSFER LETTERING
These are the well-known "rub-on" letters and numerals, which can be obtained in a vast variety of fonts, sizes and also colors. Look for them in a large artist supplies store (like H.G.Daniels in LA). Not only do such stores have a large stock, they are also the ones that carry the better brands, such as Letraset and CHART-PAK. I can not vouch for the lesser known brands often carried by drugstores and department stores. Besides, they don't offer much choice.

Using rub-on lettering requires a good deal of patience and manual dexterity. I know that some people simply can not master this and they always wind up with "dancing" letters that are also inconsistently spaced.
I prefer transfer lettering, because it can lead to very professional looking keytops, that are hard to distinguish from the real thing.

The keys have to be clean and dustfree before the transfer lettering is applied. The transfers should be properly burnished and the keys should be given several coats of a clear lacquer or varnish. BUT FIRST, CHECK THE CHEMICAL COMPATIBILITY OF THE CLEAR COAT WITH THE TRANSFERS!! Some coats could dissolve the transfers...

XI.3 USING A FULL-SIZE DOT MATRIX PRINTER
Realizing that many people may not have the patience, agility or artistic inclination for transfer lettering, I have devised a method using an 80-column dot matrix printer, black and red ribbon and adhesive-backed 1"x3.5" labels. The latter should be of the PERMANENT type and not be removable.

The ribbon should preferably be brand-new, but if you have the MSCRIPT wordprocessor, it is possible to make high-contrast printings using the built-in BOLD FACE mode, IN ADDITION to the DOUBLE STRIKE mode of your printer!

Use the CONDENSED printmode on your printer (17 char./inch) and type all 26 key-words, 26 EM commands, 33 SHIFTED EM commands (these do NOT include the 3 characters on keys Y, U and D), 6 shifted commands of keys 1 - 4, 9 and 0, 10 "color" commands (incl. TRANSPARENT and CONTRAST), BREAK, ENTER, DELETE and other dedicated keytops on the labels, leaving adequate spaces between them. These should be in BLACK. Don't forget to add the 3 hidden characters of paragraph

XI.1.1 to the commands RESET, ON ERR and SOUND!
Note: each word should be limited to seven characters, so type INV.VID instead of INV. VIDEO, TRU.VID rather than TRUE VIDEO.

Similarly, in RED, type 8 spelled-out symbols (AND, OR etc.)
In addition, SYMBOL SHIFT (the two words should be typed on two lines, one directly below the other) and this should be done twice. Leave plenty of room around these prints; we are going to make a complete keytop out of them, covering the entire upper surface of the key.

Now switch to the ELITE print mode (12 char./inch) and type all the remaining 28 symbols (!, @, # etc.). You will find that it is not possible to type symbols like <=, <> or >=. You will have to compose them with the symbols <,> and =.

Back to BLACK and still in the ELITE mode. Print the remaining 3 characters [,] and \. Also, the 8 graphic symbols on keys 1-8; most dot matrix printers have them. Remember to do these symbols "in reverse", e.g. the symbol on key 1 should be black in the first quadrant and not in the 2nd, 3rd and 4th, as erroneously depicted on the TS2068 keyboard.

Having successfully done all of the above, we are ready to cut the labels to size.
With a #11 Xacto knife, carefully cut 11 x 3 millimetre labels, properly centering the keyword, symbol or command.
Do the same with the red symbols, but limit the length of the labels to the size of the command or symbol (minimum of 3 mm for single-digit symbols, maximum of 7 mm for the longest spelled-out symbol commands).
Cut a complete keytop surface label around the SYMBOL SHIFT printings.
Next, cut out the eight graphic symbols.

Fancy your own arrowheads for the 4 cursor keys.
There is no need to replace the existing TI keytops for SHIFT (2x)

I do hope that I have been sufficiently clear in the foregoing. But I should leave something to your own judgement and creative abilities.

Using tweezers, peel-off each label and carefully position it on the appropriate key. The labels should then be firmly burnished, using a smooth piece of plastic. I like to use the cap on a "Sharpie", the well-known permanent fine-point marker. I have to emphasize cleanliness in these operations; fingerprints cause body oil to inhibit the permanence of adhesion.

Next, finish the keys on five surfaces with several coats of clear lacquer.

Figure 19 shows a typical key, finished as per above instructions. Compare it with the "S"-key on the TS2068 keyboard.
Keytops, fashioned in the manner explained by me, are surprisingly sturdy. This installment and the previous one were all typed on my first modified TI KB, in addition to typing in over 20,000 characters into a data base.
There appear to be no signs of wear! I know from experience that the original TS2068 keytops would not have survived this without some signs of scuffing...

FIGURE 19

I sincerely hope that you will indeed try the hardware projects described in these pages. Believe me, you won't know the joy of having a full-travel keyboard on your computer(s), until you own and work one!

Next installment: instructions to implement the SE-JIN TI keyboard...

--ooOOoo--

LOCAL BBS'S

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ELECT. MAILMAN 516 234-0925
TRS-80/GEN'L *
L.I.S.E. TRS-80 516 338-4063 Bill
Raferty
MIDAS 516 367-8619 Marc
Mandel
NEWLINK-80 516 422-7161 Jim
Brown 3P-2A 300 BAUD
M-BOARD 516 473-1005 Bill
Wohlars
ELCOBASE 516 473-5438 ERIC
GREEN SANYO #!
INNOV-80 516 482-8491 R.Ni
ederhoffer
MODEMTOWN 516 484-6844 J. V
elasco 7p-7a wkdys 24hrs/wknds
ROUNDTABLE 516 496-4721
IPM *!
LICA UNIX 516 541-7949 Stan
Misel
SILVER ORB BBS 516 543-7872 NICK
SURDIS !*
LICA LIMBS CBBS 516 561-6590 Dave
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FOURTH PROTOCOL 516 581-1260 RON
NFHPING *
TELETREND 516 581-8696 M.A.
Leone Fone Info $*
CONNECTION-80 516 588-5636 T. V
ande-Stouwe
GOLDEN TEMPLE 516 674-4059 Alfr
ed Levitt *
GULL BBS-64 516 681-0751 Joe
Tomasone
PIRATES COVE 516 698-4008
Apple User's *
HAM RADIO BBS 516 736-2208 N. S
ternberg 6p-8a wkdys/24hr wknds
SEARCHLIGHT 516 724-0971 Fran
k LaRosa TRS-80 !
TEXACOM 516 757-2227 R.K.
Jiminez
ELECT. MAILMAN 516 234-0925
TRS-80/GE
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BAMS 718 362-1040 Roge
r Kaplan *
CONNECT-80/QNS 718 441-3755 Robe
rt Posen RADIO SHACK *$
CONNECT-80/S.I. 718 442-3874 Stat
en Island NY *
RAVEN BBS 718 471-9015 Joe
Pure

April 28,1986

Dear Paul:

Can you can include the following classified in the next issue of List:

For sale: Aerco Floppy Disk interface for the 2068. Includes 2 5-1/4 drives and 256K of ram on the interface board. Like new condition. Total price $275. Call 212 535-1651.

I hope to make it to the next meeting and will give you a call to remind myself
Thank you.

Cem Barut

NY,NY 10028

LIST

Dear Mr. Donnelly

I would like to sell the following:

2 Timex 1000's w/ 16K Ram
1 Timex 2020 Cassette recorder
1 Timex 2040 printer
1 Carton Printer paper

As a lot $60.00

G.J. Spillman
50 Verbena Ave.
Floral Park, N.Y. 1100.

[illegible]

FROM THE DESK OF... TONY BROOKS

[illegible]

APRIL 18, 1986

L.I.S.T. GROUP

CENTRAPORT, N. Y. 11721

DEAR TIMEX / SINCLAIR USER GROUP,

I WISH TO SELL THE FOLLOWING ITEM, AS IT IS HARD TO GET SUPPORT HERE IN ALASKA. THE PRICE QUOTE IS FOR ALL NOT PIECE BY PIECE

FOR SALE:

	ITEM	APX. VALUE
(1)	TIMEX-SINCLAIR 2068	$119.00
(1)	SANYO DMC850 HI-RES. COLOR MONITOR W/RGB I/P	$500.00
(1)	WINKEY BOARD 2000	$ 20.00
(1)	MILLENNIA E DS/QD DISK DRIVE W/INTERFACE	$500.00
(1)	PRO-STICK 2	$ 30.00
(1)	LOW PROFILE KEYBOARD	$ 80.00
(2)	EXTRA POWER PAKS & CABLES	???
(1)	ROM-SWITCH	$ 45.00
(1)	BYTE-BACK MODEM (NEW)	$100.00
(1)	EXTRA T-S 2068 W/BAD BOARD-GOOD I.C.	???
(37)	TAPES & CARTRIDGES	$555.00
(15)	BOOKS FOR T-S 2068	$150.00
(1)	TIMEX-SINCLAIR 2068 TECHNICAL MANUAL W/LARGE SCHEMATIC	$ 30.00

APPROXIMATE VALUE over $2,100.00. WILL SELL ALL FOR $1,500.00. BUYER TO PAY POSTAGE. REFERENCES AVAILABLE.

FOR MORE INFORMATION: S.A.S.E. TO

CARL E. JONES
BOX 2915
KODIAK, ALASKA 99615

(907) 486-6223 (No collect calls)

KEYBOARD MANIA — Part 6

By Cedric R. Bastiaans©

XII. MODIFYING THE SE-JIN TI KEYBOARD

XII.1 PREAMBLE

Before I start with the instructions for modification of the TI-99/4A keyboard, as made by SE-JIN in Korea, I would like to state that, in order to preserve space in this News Letter, I can not and will not repeat any and all observations, previously made for the KB made by ALPS in Japan, as they may relate to the SE-JIN KB.
YOU SHOULD THEREFORE READ THE FOLLOWING INSTRUCTIONS IN CONJUNCTION WITH PARTS 3 AND 4, as well as Note 1 of Part 5!

XII.2 CUTTING THE TRACES

Make the following 29 cuts. Be VERY CAREFUL; this PCB has very poor keyswitch identification. There are no numbers to refer to, only abbreviated keytop references and these are not consistently placed. Sometimes they are between a contact-pair (as they indeed should be), other times you'll find them either to the left or to the right of such a pair. It is VERY EASY TO MAKE MISTAKES! Check and double check, before you make a cut. I found myself constantly checking the wanted spot by counting each contact-pair either from the extreme left or the extreme right.
"LEFT" and "RIGHT" refer to the location of solderpads of a given pair of keyswitch contacts.

On Switch "=", cut ALL 3 traces.
On Switch "/", cut LOWER trace to LEFT pad and the trace to the RIGHT pad.
On Switch "ENT", cut trace to the RIGHT pad.
On Switch ";", cut ALL 3 traces, but cut the one to the RIGHT pad very close to it, so that the dog-legged trace from the LEFT pad of adjacent Switch "L" remains in tact!
On Switch "FCTN", cut the trace between LEFT pad and switch "SH" above it.
On Switch ">", cut BOTH traces to the RIGHT pad.
On Switch "<", cut BOTH traces to the LEFT pad.
On Switch "M", cut the trace to the RIGHT pad.
On Switch "N", cut BOTH traces to the RIGHT pad.
On Switch "SP", cut the trace to the RIGHT pad.
On Switch "B", cut trace to the RIGHT pad.
On Switch "V", cut the trace to the LEFT pad.
On Switch "C", cut the trace leading away to the right from the RIGHT pad.
On Switch "X", cut trace leading away to the right from the LEFT pad.
On Switch "Z", cut UPPER trace to the RIGHT pad.
On Switch "CTL", cut the trace to the RIGHT pad.
On Switch "AL", cut ALL 3 traces.
On Switch "SH" on the RIGHT SIDE of the PCB (directly above the "AL"switch), cut the trace to the LEFT pad and the UPPER trace to the RIGHT pad.

XII.3 PUTTING IN THE JUMPERS

In the following, we will also assume that the Alpha Lock key will become a dedicated "*"-key. All other available extra keys are for the same dedicated functions as described for the ALPS KB, i.e. "," "." ";" ":" and "DELETE".
Furthermore, we will sometimes use the solderpads of the straps, which are on the other (not visible) side of the PCB. These straps run, with a few exceptions, horizontally and are used to bridge one or more traces.

First, install a 1-pin terminal in the area below keyswitch "=".
And another one in the area below keyswitch "X", immediately above the SE-JIN logo.

Jumper from RIGHT "A" to the LEFT "SH" on the extreme right of the PCB.

Jumper from LEFT of this "SH" switch to RIGHT "SP".
Jumper from RIGHT "SP" to the LEFT "SH" on the extreme left of the PCB.
Jumper from LEFT "ENT" to LEFT "P".
Jumper from RIGHT "=" to LEFT "0" (ZERO).
Jumper from RIGHT "/" to RIGHT "9".
Jumper from LEFT ";" to RIGHT "O" (OH).
Jumper from RIGHT "FCTN" to RIGHT "L".
Jumper from RIGHT "CTL" to RIGHT "Z".
Jumper from RIGHT "Z" to LEFT "S".
Jumper from LEFT "S" to the strap (righthand pad), located directly below switch "7". The pad connects to pin 13T of the connector.
Jumper from LEFT "X" to RIGHT "D".
Jumper from RIGHT "E" to LEFT "I".
Jumper from LEFT "K" to RIGHT "M".
Jumper from RIGHT "C" to LEFT "F".
Jumper from RIGHT "N" to RIGHT "J".
Jumper from pin 5T of the connector to pin 12T.
Jumper from RIGHT "B" to LEFT "SP".
Jumper from LEFT "SP" to LEFT "N".
Jumper from RIGHT "ENT" to LEFT "L".
Jumper the 1-pin terminal below switch "=" to the RIGHT "SH" on the left side of the PCB.
Jumper from LEFT "Z" to RIGHT "SH" on the extreme right of the PCB.
Jumper from LEFT "V" to LEFT "G".
Jumper from LEFT "V" to the remaining 1-pin terminal near the SE-JIN logo.
Jumper from RIGHT "Y" to LEFT "T".
Jumper from LEFT "CTL" to LEFT "AL".

There should be a total of 26 jumpers.

XII.4 DEDICATED KEY FUNCTIONS

Especially with this Korean PCB, it will be imperative that you mount the diodes flush against the board. There will not be much space left between it and the computer case.

PERIOD key, switch ">".
Connect two diodes, banded sides towards RIGHT ">", from RIGHT "L" and from LEFT "K".
COMMA key, switch "<".
Connect two diodes, banded sides towards LEFT "<", from RIGHT "FCTN" and from RIGHT "J".
COLON key, switch "/".
Connect two diodes, unbanded sides towards LEFT "/", from the 1-pin terminal below switch "=" and from the strap (lefthand pad) directly below keyswitch ";".
SEMICOLON key, switch ";".
Connect two diodes, unbanded sides towards RIGHT ";",from the strap directly below it (righthand pad) and from RIGHT "P".
DELETE key, switch "=".
Connect two diodes, unbanded sides towards LEFT "=", from RIGHT "0" (ZERO) and from the 1-pin terminal in this area.
ASTERISK key, switch "AL".
Connect two diodes, banded sides towards RIGHT "AL", from RIGHT "CTL" and from the 1-pin terminal in this area.

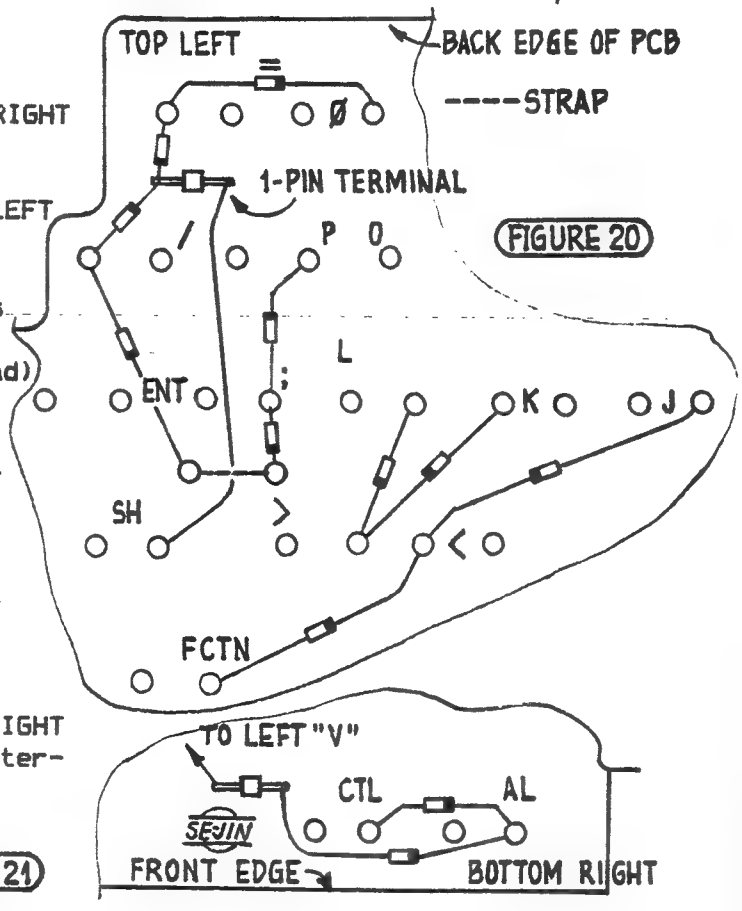

FIGURE 20

FIGURE 21

There are a few a total of 12 numbers.

XII. DEDICATED TO PUNCTION

Especially this. Dream big. It will increase the vocabulary in the right

scenario the power. There will not be dull spots left between

case

In case you need to use the "AL" key for a dedicated "@"-function instead, the modifications are:

Jumper the 1-pin terminal in the "AL" area to LEFT "1" (instead of to LEFT "V"). Connect the diodes, unbanded sides towards RIGHT "AL", from LEFT "CTL" and from this 1-pin terminal.

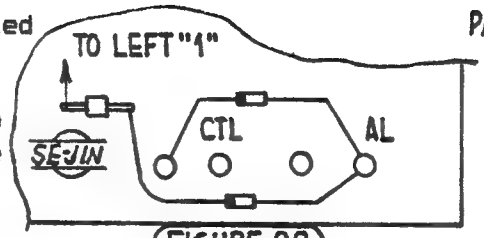

FIGURE 22

Having done this, take a straightedge, lay this diagonally across the PCB, on top of the metal flanges and check for any components that may be not be flush enough against the board.

Figure 20 shows the diode connections for the five "standard" dedicated functions. Figure 21 is for the "*", Figure 22 for the "@" connections.

XII.5 MODIFICATION OF THE COMPUTER CASE

Figure 23 shows the topview of the computer case with the FOUR cuts necessary. Cuts #2 and #3 are identical to the ones in Figure 14 of Part 4. Cut #1 is a little larger, but it is cut #4 that makes the difference.

I recommend that you try to make this cut with a Dremel tool or a milling machine. It definitely would preserve the mechanical integrity of the computer case.
It IS, however, possible to again use a jewelers or a coping saw; I have done it both ways and the end result can be just as professional looking.
Follow the outline of cut #4 if you elect to use a saw. If you use a Dremel tool/milling machine, limit the frontal cut to about 3/16 of an inch, as shown in the inset of the illustration. This prevents the cut from "opening up" completely. All other cuts are all the way to the bottom of the KB recess.

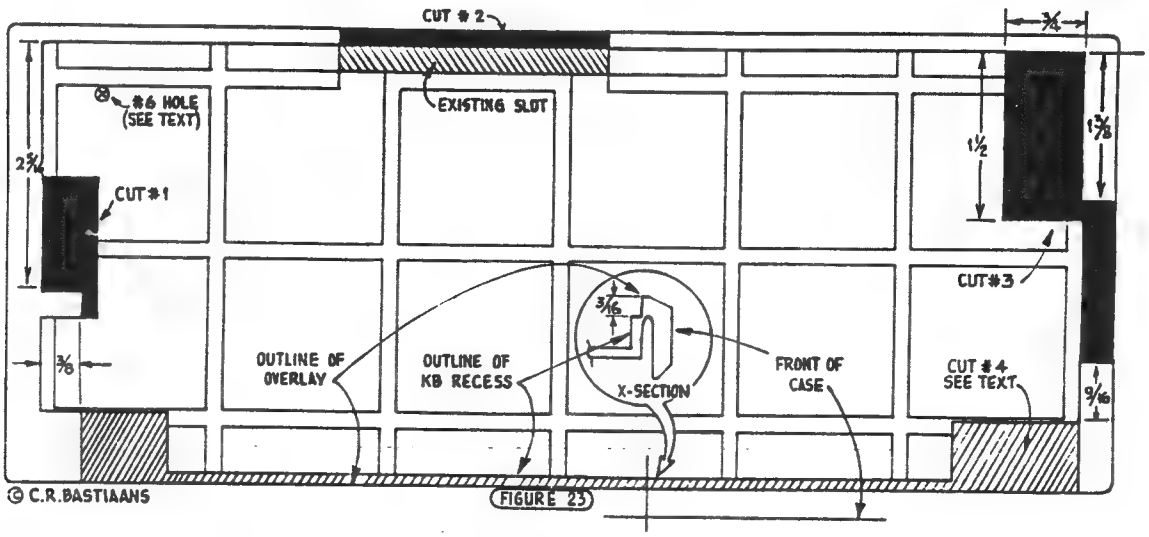

FIGURE 23

This concludes the instructions for modifying the Korean-made SE-JIN keyboard for the TI-99/4A.

There is at least one more version of the surplus KB available. It does not bear the "made in Japan" or "made in Korea" indications. In other words, it is made in the USA. Unfortunately, it carries the SAME number 1039019-1 as the ALPS KB, but it does NOT have a recessed PCB and its traces are totally different from either the ALPS or the SE-JIN boards!
It's been more than 3 months since I wrote Texas Instruments for a disclosure of the keyboard versions that the TI-99/4A might have had; they have ignored my letter.
I have no intention to investigate the third version (are there more??); I don't have the money, nor the time or the stamina. But if you set yourself to it, Figures 9 and 10 in Part 3 really contain all the information you need to solve your own trace and jumper puzzle. After you have done so, you may be able to better appreciate all the work that I have put in this article series!

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XIII. A POTPOURRI OF ITEMS OF INTEREST

XIII.1 YET ANOTHER SURPLUS TI KEYBOARD

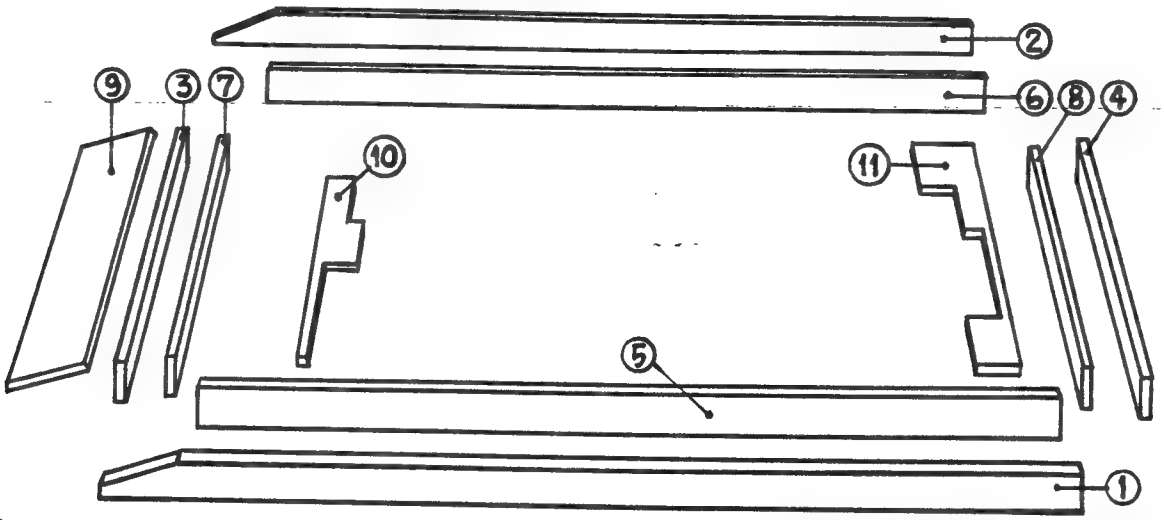
At the time that I'm writing this (end of May '86), Radio Shack has yet another special purchase item (Cat. No. 277-1023), again a surplus TI keyboard.
This is reported to be a keyboard for the TI 99/4 (without the addition A).
Even though it has the same matrix (Fig.9 of Part 3) as the other TI KB's, and it will fit inside the 2068 case, whether it has the cutouts of Figure 14 or 23, it would not be feasible to modify for use with our TS2068!
The reason: it is a membrane type keyboard! A real pity, since this item only costs $3.95...
You couldn't even consider this keyboard for spare parts; keyswitches and keytops are different from those of any of the three keyboard versions I know of.
Maybe some day, someone can come up with the proper translation circuitry to transform the TI-99/4A matrix to the TS2068 matrix and put it on an EPROM. However, we may run into a problem with certain simultaneous key-stroke commands, such as the the combination G and H keys to restart "Horace Goes Ski-ing".

XIII.2 THE BALSAWOOD MASK

Another item, which appears to puzzle some of you, is the mask, which covers up the ugly holes around the TI KB you have put in.
Figure 24 shows an exploded view of the 11 components. Dimensions are given in MILLIMETRES (mm), but these are ONLY MEANT AS A GUIDE. Before cutting each part, check the sizes you actually need for your particular KB. There are some dimensional differences between KB's!

The modified keyboard should be in place.
Cut the 1/8 inch balsawood ONLY with a #11 Xacto blade. Don't use any type of saw!

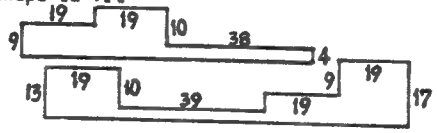
Use a fast-cure two-component Epoxy adhesive to stick the wood parts to the metal mounting brackets.
Use Elmer's Professional Carpenter's Wood Glue to glue wood to wood.
USE WAX PAPER BETWEEN THE MASK AND THE COMPUTER CASE, to prevent it from sticking together.



1=2= 260 x 10 x 240
3=4= 102 x 10
5=6= 234 x 11
7=8= 96 x 11

9= 102 x 22, shape to fit

10= 76 long;



11= 96 long;

USE 1/8 INCH BALSAWOOD THROUGHOUT
DIMENSIONS IN mm,
but are approx.

FIGURE 24

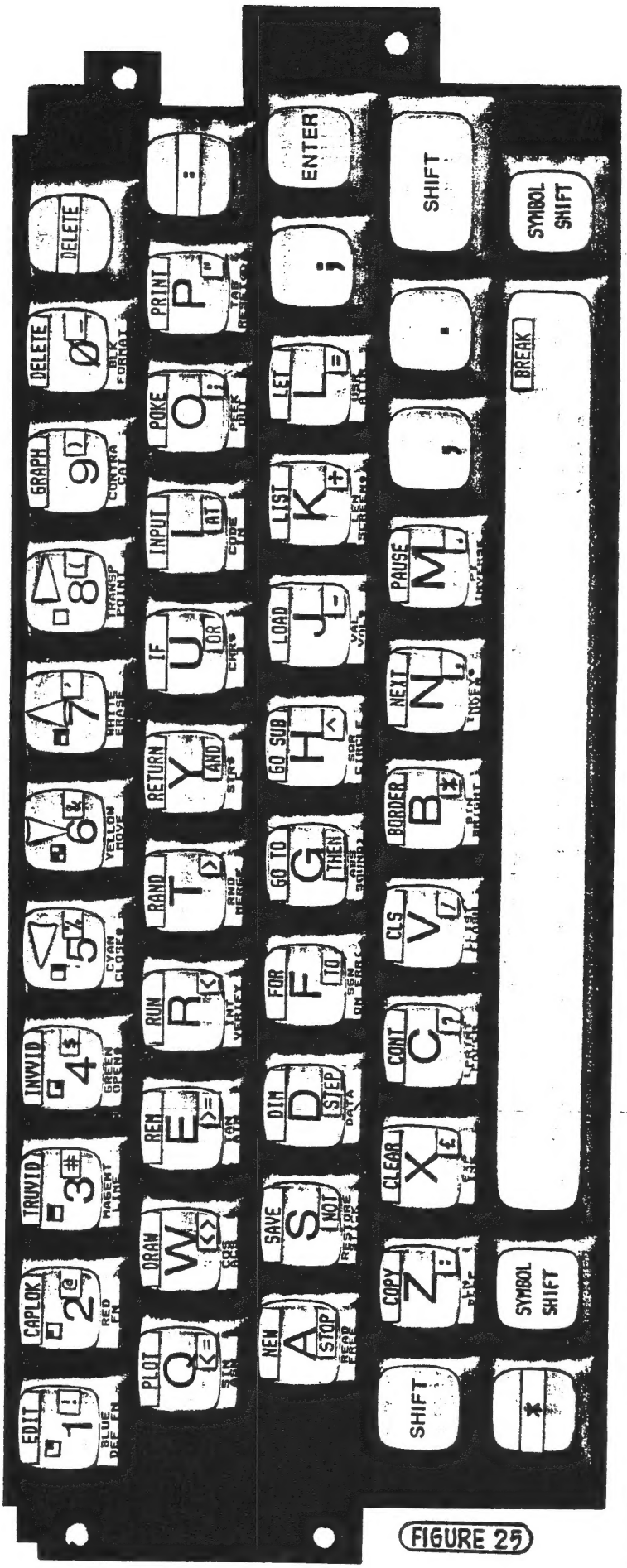
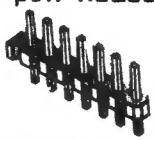


FIGURE 25

XIII.3 MULTI-PIN HEADER STRIPS

It seems that some people have a problem locating these and it might help if they knew what these components look like. Well, here is a picture of a 7-pin header strip.



XIII.4 THE TI KEYBOARD "MAKE-OVER"

Figure 25 on the left shows a full-size photograph of a completed keyboard with all of the printed keytops as discussed in section XI.3 of Part 5.

Compare these with the original keyboard of your TS2068 and see if it doesn't make a lot more sense. I suggest that you read sections XI.1.1 through XI.1.5 again so as to fully understand my philosophy.

Another tip: in order to make for surprisingly durable keytops, using the printed labels, it is important that you use a good brand clear spray, applied in many layers. I have had good luck with Red Devil High Gloss Clear Lacquer. It is an extra fast drying spray and has an adjustable nozzle. Adjust it for a HORIZONTAL spray pattern.

Never spray the keytops while they are in place. Remove them, make sure that the labels have been properly burnished and align the keys on a piece of sturdy corrugated cardboard in 5 rows, leaving about one keytop width all around each key.

USE DOUBLE-ADHESIVE TAPE to prevent the keys from shifting about.

Spray in a dustfree environment and spray in slightly overlapping vertical movements.

Turn the cardboard substrate 90 degrees and spray again. Repeat this two more times and allow to dry for several hours. Repeat the entire process one more time. When you're all done, the top surface of each key has had 8 coats and each vertical surface has had 2. Right?

This concludes my Keyboard Mania series. I hope that it gave you the impetus to try your hand on a worthwhile hardware project! I would appreciate hearing from you. Good luck!

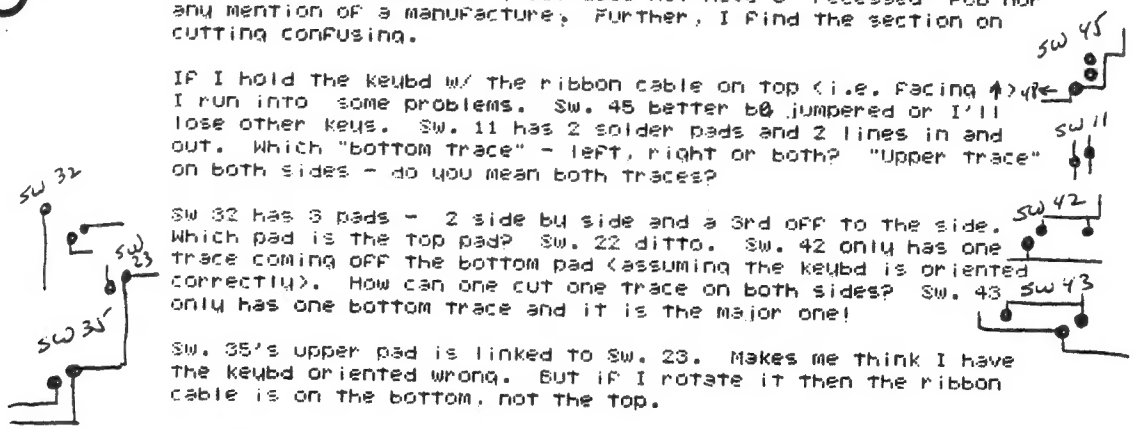
Readers Feedback

Dear Cedric,

4-30-86

Have enjoyed you article Keyboard Mania - especially part 3. In fact I just received my TI keyboard. And in reviewing your instructions I find some problems.

My keyboard is#1039019-1, but does not have a "recessed" PCB nor any mention of a manufacture. Further, I find the section on cutting confusing.



IF I hold the keybd w/ the ribbon cable on top (i.e. facing ↑) I run into some problems. Sw. 45 better b@ jumpered or I'll lose other keys. Sw. 11 has 2 solder pads and 2 lines in and out. Which "bottom trace" - left, right or both? "Upper trace" on both sides - do you mean both traces?

Sw 32 has 3 pads - 2 side by side and a 3rd off to the side. Which pad is the top pad? Sw. 22 ditto. Sw. 42 only has one trace coming off the bottom pad (assuming the keybd is oriented correctly). How can one cut one trace on both sides? Sw. 43 only has one bottom trace and it is the major one!

Sw. 35's upper pad is linked to Sw. 23. Makes me think I have the keybd oriented wrong. But if I rotate it then the ribbon cable is on the bottom, not the top.

Almost all the other switches have similar problem. Further, your drawing of the TI matrix has the Alpha Lock on top - my keybd has it on the bottom.

I'll not cut until I get the next issue of LIST, but I think that you need to clarify your instructions a bit more - especially if there are more than one kind of keyboard out there. Looking forward to your reply - or mention of it in the article. etc.

Dear L.L.

L.L.

In Page A of Part 3 I have clearly identified TWO Texas Instruments TI-99/4A Keyboards, both of foreign make. US law requires that all imported goods be properly identified as to the country of manufacture.

Therefore, if your TI keyboard does not have any such indication, it simply means that it was made here in the USA.

It is very unfortunate that your keyboard shows the same 1039019-1 number as the ALPS-made KB, which has - contrary to your KB - a recessed PCB.

More than 2 1/2 months ago, I wrote to Texas Instruments for clarification on all versions of their TI-99/4A keyboard, even though I had no intention of trying to modify ALL of such versions for inclusion in the TS 2068 computer case. After all, who has the time or the money for such a mammoth project. I just wanted the information so that I could advise people with questions, just like you. TI has elected not to answer my letter.

Anyway, it should be clear that the trace cutting instructions given in page C of Part 3 do not apply to your particular KB. I clearly indicated in line 11 of page A, Part 3, that the procedures to be described were only for the KB in question, the ALPS KB, made in Japan, with a recessed PCB.

No wonder then, that you could not make head nor tail of my trace cutting instructions. Once again, they don't apply! And I can certainly not comment on the descriptions with the illustrations that you gave in your letter. All I can say is, that they have also no relation to the SE-JIN KB (made in Korea), full instructions of which will follow at a later date.

As to your remark about the matrix drawing showing the Alpha Lock on the top. The matrix is a SCHEMATIC depiction of wiring, printed circuit or point-to-point. It is drawn for maximum CLARITY and in most cases has little to do with the physical layout of the components. Look at the keys in the matrix, marked /,=,;,EN,SP,FN,CT and SH. These too are not depicted according to their physical layout; and you can maybe imagine yourself how confusing the matrix would have become, if indeed they had been!

Concluding, there is nothing for me to add to the already VERY CLEAR instructions in my Keyboard Mania series. They just don't apply to your keyboard. I'm sorry.

All I can do, is point out to you that with the help of Figures 9 and 10 on Page B of Part 3, you should really be able to find out which traces to cut and where to put jumpers. Figure 9 shows you the situation on your KB, whereas Figure 10 shows you what it should become. Since you appear to have some misconceptions about matrices, maybe I should tell you that if on Figure 9, I have indicated that key Z is connected to key A, that it need not in actuality be so connected! Depending on how the traces on the KB are laid out, key Z may be connected to key Q, or key 1, or key 0, or key P, or key ; or key / or it may indeed be connected to key A! What REALLY matters is that all of these keys are on one side of their contacts, ULTIMATELY CONNECTED to pin 8T of the 15-pin ribbon connector!

A final word: you don't have to worry about the 29 keys depicted in thin blocks in Figure 10; these are already properly connected. However, sometimes one or more of these keys get inadvertantly disconnected from their address or KBD lines, because of the trace cuts necessary for the matrix modifications of the other keys! A jumper to the appropriate point(s) will correct such situations.

Thank you for your interest in my article series and I hope that you will persist and eventually solve the matrix puzzle and build the TI KB into your 2068. It is really worth the trouble... -Cedric-